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AGRICULTURAL EXPERIMENT STATION
MICHIGAN STATE COLLEGE
Of Agriculture and Applied Science

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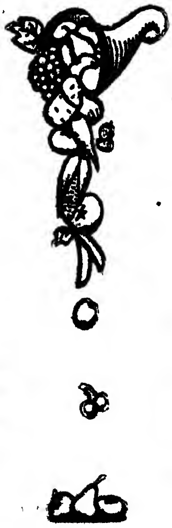

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EDITED BY
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CONTRIBUTIONS BY ALL SECTIONS OF THE
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Vol. XIII, No. 1, August, 1930

FERTILIZING HELPS THE JUNE CLOVER CROP

Fertilizers, Especially Potash Carriers, Seem Quite Essential on Sandy Soils.

A. G. WEIDEMANN, SOILS SECTION

Despite the rapid increase in acreage of the valuable legumes, alfalfa and sweet clover, we still find June clover occupying a basic position in the crop rotation of many Michigan farms. Regardless of the fact that this crop has been grown for many years, we are still finding out things experimentally concerning its response to cultural methods and especially to fertilizer treatments.

As a result of rather favorable weather conditions, the 1929 crop of June clover produced an abundance of high quality seed in most sections of the state, resulting in a rather moderate price for seed for 1930. Yields as high as five bushels of seed per acre were reported, some of which sold for less than $12.00 per bushel. At that price, a farmer is inclined to seed a somewhat larger acreage of this crop than usual. But even at $12.00 per bushel, and especially at the frequently prevailing price of $20.00 or $22.00 per bushel, he cannot afford to sow it without assurance of getting a crop.

It is very common to hear farmers tell how they used to raise an abundance of clover but how difficult they have found it to obtain good stands in recent years. This change, no doubt, is due to the gradual depletion of the natural fertility and the lime content of the virgin soil. It is commonly known that June clover and especially alsike clover will do fairly well on soils which are too sour to produce alfalfa or sweet clover, yet even these crops will respond to applications of lime on soils that need it.

With the introduction of the practices of limeing the soil and inoculating the seed, there has been a general opinion that the hazards associated with the growing of clovers have been eliminated but, judging from the results of our experiments, we have every reason to believe that a reasonable supply of certain plant food elements is as important as any other factor in producing good yields of these crops.

Two of the field experiments which the soils department of Michigan State College has conducted on Hillsdale sandy loam soil during the past few years have produced very interesting results.

Experiments on the Tanner Farm in Jackson County

On the farm of R. V. Tanner, in Jackson County, an experiment was started in 1926, with a four-year rotation consisting of corn, oats, wheat,

Figs. I, II, and III.

Potash or barnyard manure seems quite essential to the production of clovers on sandy soils.

Fig. 1—Left: no treatment. Right: lime, sodium nitrate and potash.
Fig. II—Left: no treatment. Right: lime and manure.
Fig. III—Left: lime and phosphorus. Right: lime and potash.

and June clover. Four fields were used, thus making it possible to harvest each crop every year. At the beginning of the experiment, lime was applied to the lime plots. Fertilizer applications were made on the fertilizer plots at that time and have been repeated every second year since with the exception of nitrogen which was applied every year except with clover. The treatments along with the clover yields are given in Table 1. Regular fertilizer applications were made for corn and wheat.

Table 1.—Yield in pounds per acre of June clover hay on a Hillsdale sandy loam soil in Jackson County.

Treatment	Yields, in pounds, of dry hay per acre	
	1929	1930
None	674	...
Lime	438	...
Lime, Nitrogen, Phosphorus, Potash	3,915	1,987
Lime, Nitrogen, Phosphorus	346	
Lime, Nitrogen, Potash	3,696	1,490
None	428	...
Lime	417	...
Lime, Nitrogen	808	
Lime, Potash	4,037	1,145
Lime, Phosphate	317	...
Lime, Phosphate, Sulphur	864	...
None	518	...
Lime	720	...
Lime, Phosphate, Potash	4,380	2,208
Lime, Phosphate, Potash, Manure	4,099	2,108
Lime, Manure	4,664	2,039

As a general thing, if a soil does not grow a crop, it is very likely to grow weeds. This statement proved true in the case of this experiment, and it became necessary to estimate the percentage of clover on the plots in determining the yields. The yields given in this article do not include weeds which grew on the plots.

An examination of Table 1 reveals the fact that in 1929 the yields of clover were very small on all plots except those which were treated with potash or barnyard manure, while in 1930 there was no clover at all on the plots which did not get potash or manure. On this field other fertilizer elements, or combinations of fertilizer elements, not including potash seemed to have no effect on the production of clover. The decreased yield of clover in 1930 and the total lack of clover on the non-potash plots in the same year was perhaps due to the extremely dry summer of 1929, since there was a fairly good catch of clover on all plots shortly after seeding it.

Experiments on the H. A. Gowdy Farm in Branch County

On the farm of H. A. Gowdy, in Branch County, a similar experiment was started in 1928 on the same type of soil, although this soil was in a better state of fertility than that on the Tanner farm. The plan of this experiment called for a four-year rotation of the same crops that were grown on the Tanner farm, although the treatment

was somewhat different. Four fields were used here also in order that each crop could be grown every year. On this project, lime and fertilizers were applied at the beginning of the experiment and fertilizers are being applied every second year with two exceptions: (1) nitrogen is being applied every year except with clover, and (2) rock phosphate is being applied every fourth year with corn. The fertilizer and lime treatments along with the clover yields are shown in Table 2. The regular applications of fertilizer on this field were made with corn and wheat, the same as on the Tanner Farm.

Table 2.—Yield in pounds per acre of June clover hay, on a Hillsdale sandy loam soil in Branch County.

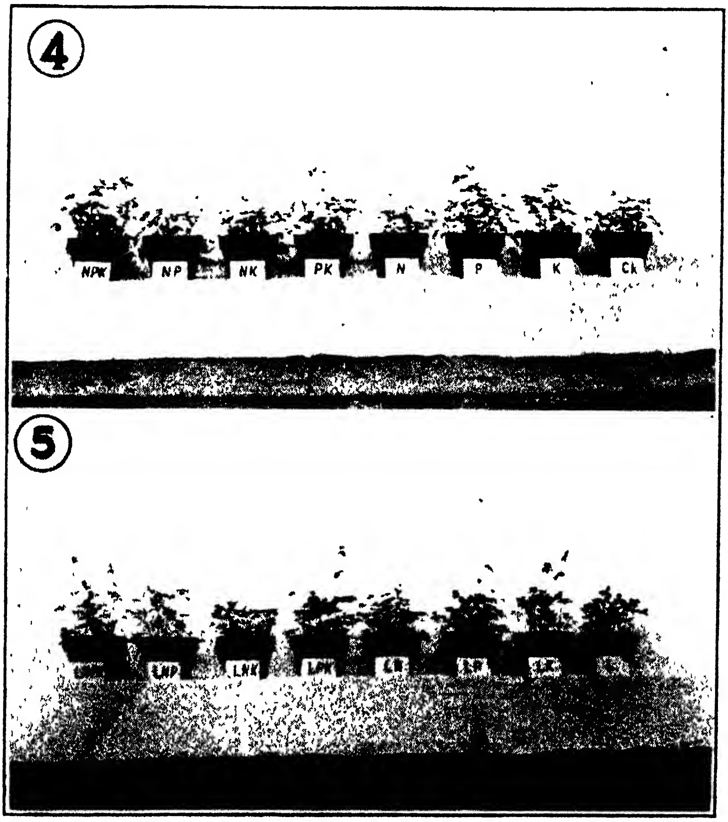
Treatment*	Yields of dry hay per acre	
	1929 Pounds	1930 Pounds
Check	3,610	1,047
4-16-0	3,993	1,934
4-16-4	3,610	1,431
Check	2,861	814
4-16-8	3,610	2,868
4-16-12	4,723	2,618
Check	3,225	814
0-16-4	3,513	1,629
2-16-4	3,513	1,896
Check	2,880	None
6-16-4	3,878	672
4-16-4	4,589	Trace
Check	4,205	None
4-8-4	3,995	2,232
4-24-4	4,377	2,699
Check	3,725	1,407
0-16-8	4,339	1,177
0-16-16	4,416	2,073
Check	5,107	Trace
0-16-0	3,878	810
0-16-0—500 lbs	4,608	3,601
Check	5,069	1,566
0-16-0—Plus Manure	5,030	3,710
Manure	4,531	2,221
Check	4,570	383
Rock Phosphate— 500 lbs plus manure	4,953	2,843
Rock Phosphate—1,000 lbs. plus manure	4,973	2,443
Check	4,147	294
15-30-15—125 lbs.	4,147	2,332

*All plots were limed.
*Fertilizer applications were 250 lbs per acre except where indicated differently.

There was not much correlation between fertilizer treatment and clover yield on this project in 1929 but, in 1930, this relationship was very striking. The yield of clover hay on every unfertilized, or check, plot in 1930 was comparatively low and, on some of these check plots, there was no clover at all. It seems, in this case, that any fertilizer treatment was beneficial to the clover crop, and there was not the striking difference between potash plots and non-potash plots that we found on the Tanner field. This might be accounted for by the fact that barnyard manure had been used quite freely on this soil before it was taken over for experimental use, and manure contains potash, the effects of which can be observed for several years after its application.

Greenhouse Experiments

As no plot on the Tanner farm produced clover without either potash or manure and as there were no potash or manure plots which were not limed, it was considered advisable to bring some of the untreated soil into the greenhouse and attempt to find out if clover could be grown on it by treating it with potash without the additions of lime. Accordingly, one set of pots was prepared containing soil treated with lime and various combinations of fertilizer, while a similar set was prepared from the same soil treated with the same combinations of fertilizer but no lime. Clover was grown in these pots till it reached the blossom stage. The tops were then removed and the plants allowed to grow up again. When it approached the blossom stage the second time, it was photographed and the photographs are shown in figures IV and V. The treatments are shown in the photographs: L, means lime; N, nitrogen; P, phosphorus; and K, potash.



Figures IV and V.

Clover grown in the green house on soil from Tanner farm treated as indicated in photograph.

L = lime, N = nitrogen, P = phosphorous, K = potash

The need of potash in growing clover on this soil is not so apparent when the plants are not subjected to the hardships encountered under field conditions.

The characteristic effect of potash which we saw in the field experiments does not show up in the greenhouse work. The fact seems to be revealed that, in the greenhouse, the clover plants will grow in this soil with any fertilizer treatment or with no fertilizer treatment. There are differences in growth, however, due to different treatments but the differences appear to be in favor of phosphorus rather than potash.

Possible Explanation of Variations in Field and Greenhouse Results

Attention has already been called to the fact that on the Tanner field the stand of clover was good shortly after it was seeded in wheat in the spring, but that at harvest time the following year there was no clover left except on the potash or manure plots. Also, that in the greenhouse any fertilizer treatment, and even no fertilizer treatment, produced clover. The difference between the two conditions was that the greenhouse clover was grown under controlled conditions of moisture and temperature while that grown in the field was subjected to a long severe summer drought and a long, hard winter.

It seems, in this case, that the difference between a yield of clover and no yield of clover is governed largely by the presence or absence of available potash in the soil, and that the effect of potash lies largely in its ability to produce a hardy, resistant plant capable of withstanding the hardships it is subjected to under field conditions.

It would seem to be good judgment on the part of farmers handling light soil, who intend to seed clover in their wheat in the spring, to consider these things carefully in fertilizing their wheat fields this fall. No results of the potash fertilizer are likely to be observed on the wheat, but for the sake of the clover that is to follow a fertilizer which is fairly high in potash should be chosen.

COMMERCIAL MIXED PROTEINS FOR SWINE TESTED

Find Hundredweight of Gain Costs More With Prepared Supplements

BY G. A. BROWN, ANIMAL HUSBANDRY SECTION

Michigan livestock producers use a great deal more feed than is grown in the State. It has been estimated that 5,000 carloads of corn and 1,000 carloads each of oats and barley were shipped into the state last year, to say nothing of thousands of carloads of commercial mixed feeds which were sold. The scarcity of feeding grains in this state makes it a fertile field for the salesman of commercial mixed protein supplements and other mixed feeds.

The cost per unit of protein in the commercial mixed supplement is invariably higher than in the straight supplements such as tankage, linseed meal, cottonseed meal, soy bean oil meal, or gluten meal. The cost per pound of total digestible nutrients is also much higher in these commercial mixed protein supplements than it is in farm grains such as corn, barley, oats, wheat, or rye.

Experiment No. 1

	Lot No. 1 July 7-Nov 6, 1927	Lot No 2 July 7-Nov 6, 1927	Lot No. 3 July 7-Dec. 4, 1927
Number pigs per lot	8	8	8 (5 pigs finished)
Protein supplements	Tankage, 2 parts Linseed meal, 1 part Self-fed	Skim Milk Trough fed	Purina Pig Chow Trough fed
Initial weight per pig	42 12 lbs	42 25 lbs	42 12 lbs
Final weight per pig	198 25 "	199 5 "	202 8 "
Average daily gain	1 235 "	1 280 "	989 "
Average daily ration			
Shelled corn } Self-fed	2 989 "	2 598 "	2 004 "
Ground oats } Self-fed	1 063 "	1 106 "	969 "
Tankage }	284 "		. ...
Linseed meal, } Free choice	142 "		.
Minerals }	013 "	018 "	007 "
Alfalfa hay }	169 "	183 "	163 "
Skim milk }		6 114 "	
Purina Pig Chow—Trough fed			1 421 "
Total daily feed	4 66 "		4 564 "
Grain, Minerals and Alfalfa		3 905 "	
Skim milk		6 114 "	. . . .
Feed consumed per cwt gain			
Grain	328 12 "	286 65 "	300 6 "
Minerals	1 079 "	1 43 "	698 "
Alfalfa	13 69 "	14 23 "	16 48 "
Protein supplement	34 53 "	474 06 "	143 66 "
Total	377 42 "		461 44 "
Grain, Minerals and Alfalfa		302 31 "	.
Skim milk		474 06 "	. . . .
Feed cost per 100 lbs gain	$7 01	$6 30	$10 04

Experiment No. 2

	Lot No 1 Dec 22, 1927 to May 8, 1928	Lot No 2 Dec 22, 1927 to May 8, 1928	Lot No 3 Dec 22, 1927 to June 10, 1928
Number of pigs per lot	8	8	8
Protein supplements	Tankage Self fed	Skim milk Trough fed	Purina Pig Chow Trough fed
Initial weight per pig	47 12 lbs.	46 75 lbs.	47 75 lbs
Final weight per pig (6 pigs)	202 "	202 75 "	190 71 " (7 pigs)
Average daily gain	1 05 "	1 13 "	.78 "
Average daily ration			
Shelled corn }	3 75 "	3 17 "	3 23 "
Tankage } Self-fed	52 "		. .....
Minerals } Free choice	01 "	01 "	....
Alfalfa }	16 "	05 "	. .. .
Skim milk }		7 30 "	. ...
Purina Pig Chow } Trough fed	.	.	97 "
Total daily feed	4 43 "	.	4 20 "
Grain, Minerals and Alfalfa	.	3 23 "	.. ..
Skim milk	.	7 30 "	. . ..
Feed consumed per 100 lbs gain:			
Corn	354 53 "	280 53 "	414 67 "
Minerals	63 "	48 "	. . . .
Alfalfa hay	15 22 "	4 41 "	.. ..
Protein supplements...	48 65 "	645 66 "	123 75 "
Total..	419 03 "		538 42 "
Grain, Minerals and Alfalfa		285 42 "	.. . .
Skim milk	.	645 66 "	.. ..
Feed cost per 100 lbs. gain..	$8 13	$6 56	$11 28

Experiments No. 1 and 2 were conducted by W. E. J. Edwards.

The majority of these commercial mixed feeds are sold as a substitute for linseed meal, cottonseed meal, or tankage; the claim being made that the commercial mixed protein supplement is superior because of the large number of sources of protein and also because of vitamin and mineral content. It is also claimed that less feed is required to produce 100 pounds of gain when these mixed feeds are used.

Trials were conducted to determine the accuracy of these claims and the economy of using these commercial mixed protein supplements as compared with tankage or skim milk.

No open formula feeds were used in these experiments. The closed formula feed may be changed in composition at any time and the feeds sold under the same name may be different in composition at the present time. All feeds used were purchased on the open market before the start of the experiment.

Feed prices. Shelled corn, $1.75; ground oats, $1.75; tankage, $3.75; linseed meal, $2.75; minerals, $1.50; alfalfa hay, $0.60; skim milk, $0.25 and Commercial Mixed Protein Supplements, Purina Pig Chow, $3.25, Purina Hog Chow, $3.95, Wayne 28 Per Cent Hog Meal, $3.25 per cwt.

Mineral mixture used. Special steamed feeding bonemeal 45 pounds, fine ground limestone 20 lbs., and salt 30 lbs.

The tankage used contained 60 per cent of protein, the Purina Pig Chow 20 per cent of protein, and the Purina Hog Chow 31 per cent of protein.

Experiment No. 2 differed from No. 1 in that Lot 3 was not given access to any minerals or alfalfa hay as the Purina Pig Chow used contained both alfalfa leaf meal and minerals. Lot 3 made both slower and more expensive gains in the second trial than was the case in the first trial.

In both trials, skim milk at $0.25 per cwt. proved the most efficient supplement with tankage second and the Purina Pig Chow third.

Had the skim milk fed to Lot 2 been charged at $0.41 per cwt. in the first experiment and $0.49 per cwt. in the second experiment the cost of gains in Lot 2 would have been the same as in Lot 1. With tankage

Experiment No. 3

		Lot No. 1 July 17 to Oct. 15, 1929	Lot No. 2 July 17 to Oct. 15, 1929	Lot No. 3 July 17 to Oct. 15, 1929
Number of pigs per lot		10	10	10
Protein supplements		Tankage	Purina Hog Chow	Wayne 28% Hog Meal
Initial weight per pig		48 23 lbs.	48 1 lbs.	48 4 lbs.
Final weight per pig		167 16 "	150 96 "	166 4 "
Average daily gain		1 32 "	1 14 "	1 31 "
Average daily ration:				
Shelled corn		3 35 "	2 50 "	3 08 "
Ground oats		.30 "	.31 "	.47 "
Tankage	Self-fed	.55 "		
Purina Hog Chow	Free choice		1 31 "	
Wayne 28% Hog Meal				1.11 "
Total daily ration		4 20 "	4 12 "	4 66 "
Feed consumed per 100 lbs. gain:				
Grain		276 53 "	245 9 "	270.75 "
Protein supplement		41.62 "	114.8 "	84.75 "
Total		318.15 "	360 7 "	355.50 "
Feed cost per 100 lbs. gain		$6 40	$8 84	$7 49

at $3.75 per cwt. and linseed meal at $2.75 per cwt., the value of skim milk for pork production as indicated by these trials was from forty to fifty cents per cwt.

In this experiment, no alfalfa hay, salt, or minerals other than that contained in the feeds were fed any one of the three lots. Purina Hog Chow was said to contain six different feeds, salt, and charcoal. The analysis show 31 per cent protein.

Wayne 28% Hog Meal was said to contain nine different feeds, salt, and six mineral elements. Both commercial mixed protein supplements contained tankage and alfalfa leaf meal.

All three lots were confined in the central hog house with access to a cement floored yard. Lot 1, therefore, did not receive at any time salt, minerals or alfalfa hay. In spite of this handicap Lot 1 receiving only shelled corn, ground oats and tankage made much cheaper gains, due to the fact that Lots 2 and 3 consumed more of the commercial mixed protein supplements than Lot 1 did of tankage.

Experiment No. 4

	Lot No 1 Jan 2 to May 12, 1930	Lot No. 2 Jan 2 to May 12, 1930
Number of pigs per lot	7	5
Protein supplements—Self-fed	Tankage	Wayne 28% Hog Meal
Average initial weight ..	42 42 lbs.	42 4 lbs.
Average final weight ..	200 42 "	204 6 "
Average daily gain	1 21 "	1 24 "
Average daily ration:		
Shelled corn . } Self-fed	3 86 "	4 35 "
Tankage }	.52 "	....
Wayne 28% Hog Meal }		1 05 "
Total daily feed	4 38 "	5 41 "
Feed consumed per 100 lbs gain		
Shelled corn	317 54 "	349 "
Protein supplements	42 76 "	84 52 "
Total	360 30 "	433 52 "
Feed cost per 100 lbs gain .	$7 16	$8 85

All three lots had access to a simple mineral mixture and alfalfa leaf meal, the consumption was so small that it was not considered in computing the results.

In this as in each of the other three trials the lot receiving shelled corn and 60 per cent protein tankage required less feed per 100 pounds gain and made much cheaper gains than did any lot receiving shelled corn and commercial mixed protein supplements.

The higher cost per pound of gain made by the lots receiving the commercial mixed protein supplements was largely due to the fact that the pigs ate more of these feeds in an effort to balance their ration than the pigs did of tankage in Lot 1.

If the Purina Pig Chow fed in the first experiment had been purchased at $1.15 per hundredweight and that used in the second experiment at $0.70 per hundredweight, the cost of the gains produced would have been the same as they were when tankage was used as a protein supplement in the respective experiments.

The Purina Hog Chow fed Lot 2 in the third experiment would have

to be purchased at $1.82 per hundredweight and the Wayne 28 per cent Hog Meal fed Lot 3 at $1.96 per hundredweight to produce gains at the same cost as the gains of Lot 1 receiving tankage as a protein supplement.

Many local mills and elevators are installing mixing machinery and are prepared to sell the livestock feeder high grade protein supplements such as linseed oil meal, tankage, fish meal, cottonseed meal, gluten meal, or soybean oil meal and mix them with farm grains in the correct proportion to give a well balanced ration at a minimum cost without any filler or low value by-products. The various livestock departments at Michigan State College are glad to provide formulas to both feeders and mills rendering this service.

RINGING FRUIT TREES SOMETIMES SPREADS BLIGHT

Practice of Hastening Fruiting by Girdling May Cause Serious Disease Infection

H. A. CARDINELL, HORTICULTURAL SECTION

Recent tendencies in the management of young apple orchards have favored very vigorous growth. This condition results in the trees being large when they are of bearing age, with framework extensive enough to produce heavy crops, but at the same time it lessens the bearing tendency. With varieties which are naturally rather slow in coming into bearing, this deferred production may be serious. Among the practices designed to promote early bearing in vigorous trees, ringing (girdling) has been tried from time to time.

At the Graham Horticultural Experiment Station at Grand Rapids, several treatments designed to induce fruiting in Northern Spy trees 7 to 10 years old have been compared. A preliminary report of this work was published in the 1928 (58th) Annual Report of the Michigan State Horticultural Society, page 116. The present paper presents a case showing possible complications arising from the practice of ringing.

In 1927, before the Experiment Station work was undertaken, the Huron Farms Company began a three-year program of scoring. Each year two rings were cut one-eighth inch apart around each limb, without removing the bark, on a third of the limbs of each tree of vigorous varieties that had not blossomed by their tenth and eleventh seasons in the orchard. This work was completed according to schedule in May, 1929.

In 1927 and 1928, no blight infection followed the ringing operation. In 1929, a year when blight was rampant, serious infection resulted from ringing.

Two varieties, Baldwin and Northern Spy, received ringing. The proportion of infection originating in the ringed wounds is indicated in the table.

	Trees Ringed	Trees With Blight
Baldwin	437	146
Northern Spy	176	1

In many rows in this orchard Baldwin and Spy alternate. Consequently, the operator, working along the rows, taking each tree, spread blight in the Baldwins but not in the Spy trees.

Since, however, no common variety of apple is known to be immune to fire blight and since vigorous trees are particularly susceptible, prophylactic methods in ringing would seem only wise. First, if there is blight in the top of a tree, ringing that tree is likely to provide a source of infection in a very vulnerable spot and is a questionable practice. To prevent possible spread of infection by the knife itself, the knife blade should be sterilized before each cut is made.

Mercury-Glycerine Disinfectant

The formula recommended is the new mixture given by L. H. Day in California Agricultural Extension Service Circular 20, "Pear Blight Control in California" (Berkeley, California).

Figure I—Three seasons scoring of limbs on Baldwin. In two seasons no infection; in 1929, 146 of a total of 437 ringed Baldwin trees blighted. Knives used in ringing should be continually treated with the mercury formula given in this article.

1 pint distilled water (or rain water)
3 pints cheapest commercial glycerine
8 large tablets ($7\frac{1}{2}$ grains or half gram) cyanide of mercury or $\frac{1}{8}$ ounce of the cheaper crystals.
8 large size tablets bichloride of mercury (or $\frac{1}{8}$ ounce crystals).

Add the water to the glycerine in a clean enameled kettle. Heat warm enough to dissolve the cyanide of mercury in this by stirring with a clean dry stick. Next add the bichloride of mercury and stir until dissolved. Glycerine is the most expensive ingredient, yet it is

Figure II—Some of the trees were ringed on the trunk in 1929. Blight entering these wounds impaired the entire tree instead of one limb.

recommended, because it spreads so much better on tools and penetrates a wound better than a water mixture. If glycerine is not used, three quarts of distilled or rain water should be substituted.

Disinfection can be accomplished by merely dipping the knife blade in the solution. It may be more convenient, however, to carry the solution in a bottle and to wipe the knife with a saturated cloth.

This formula is very poisonous, if taken internally by children or animals. The glycerine is attractively sweet. Keep the mixture under lock and key and do not leave work bottles or tablets on bench or floor if small children are about.

Additional Precaution

Mercury is injurious to gold; consequently, operators should not wear gold rings or handle gold watches while their hands are covered with the disinfectant.

Antidote

In case of accident, administer white of egg and then induce vomiting by use of mustard water, 2 to 4 teaspoonfuls of mustard thoroughly stirred into a cup of warm water. Rush the patient to a physician or hospital.

LACTATING DAIRY CATTLE NEED PLENTY OF WATER

Trials Show Milch Cows Consume More Than Sixteen Gallons Daily

BY L. A. MOORE AND G. A. BOWLING, DAIRY SECTION

Water is a very important factor to consider in the nutrition of lactating dairy cattle when it is considered that approximately 87 per cent of milk, as well as a large percentage of an animal's tissues, is in the form of water.

The chief functions of water in the animal body are to dissolve the food material and to serve as a medium of its distribution, to remove waste products from the body cells, and to control the temperature within certain limits by means of evaporation.

According to one investigator, approximately 56 per cent of the water consumed by a dairy cow is eliminated in the feces, about 13 per cent through the kidneys as urine, 12 per cent through the skin, during the winter, and about 15 per cent is used to produce milk. During the summer, approximately 27 per cent of the water may be eliminated through the skin compared to 12 per cent during the winter.

Although water is of prime importance to the body processes, very little data have been reported relating to the water consumption of lactating dairy cows.

In connection with an experiment conducted by the dairy section of the experiment station, water consumption of 10 lactating dairy cows was measured over a period of four months by means of placing meters on the individual drinking cups of the cows. These meters were read daily. A few very interesting observations were made.

The total and average daily milk production and water consumption of the 10 cows for the four months period is shown in Table 1. These trials extended from March 25, 1929 to July 22, 1929.

According to Table 1 the 10 cows produced an average of 44.0 pounds of milk daily and consumed an average of 16.68 gallons of water daily during this period or approximately 140 pounds. For every gallon of water consumed, they produced 2.69 pounds of milk, or, expressed in another way, these animals consumed about 3.4 pounds of water for every pound of milk they produced.

Table 1.—Showing total and average daily milk production and water consumption.

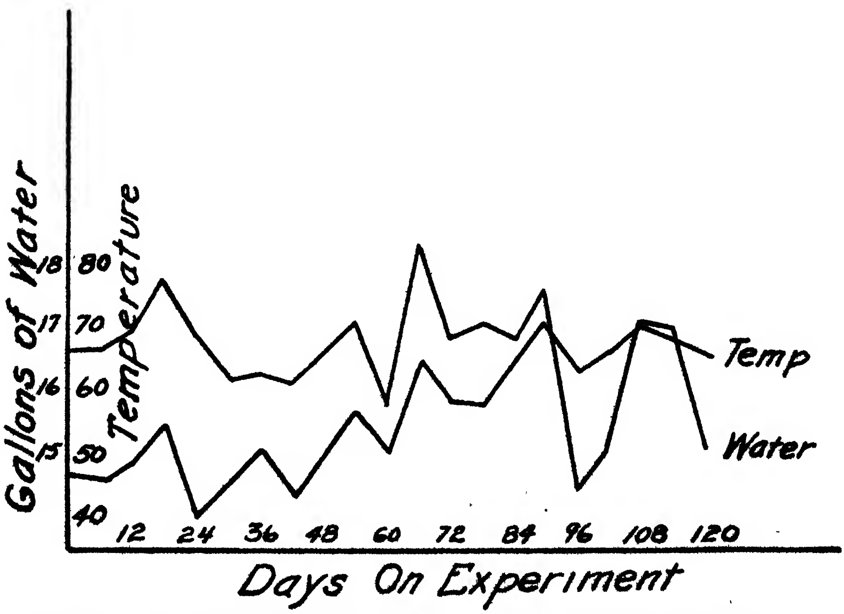
Animal No.	Total milk produced	Average daily milk production	Total water consumption	Average daily water consumption	Lbs. of milk per gal. of water consumed
	Pounds	Pounds	Gallons	Gallons	Pounds
226	5,774 3	48 1	1,864 0	15 53	3 10
225	4,746 5	39 6	1,822 5	15 19	2 61
229	4,773 0	39 8	1,791 0	14 93	2 67
187	6,254 4	52 1	2,136 75	17 80	2 93
168	5,855 4	48 6	2,304 50	19 20	2 53
232	5,486 8	45 7	1,962 5	16 35	2 80
230	3,437 5	28 6	1,614 75	13 46	2 12
189	5,043 7	42 1	1,867 75	15 56	2 71
174	5,718 2	47 7	2,214 25	18 45	2 59
150	6,879 6	57 3	2,441 50	20 35	2 82
Average	....	44 0	....	16 68	2 69

Effect of Temperature on Water Consumption

A further study of the data obtained on this experiment revealed that the variation of atmospheric temperature had an effect on the water consumed. This is brought out in Graph 1. Daily water consumption and daily temperatures were averaged into 6-day periods and plotted.

It will be noted from the graph that as the average daily temperature rose, the water consumption also rose and vice versa.

Because of the large amount of water required by lactating cows, as



Graph I. Showing Relationship between Temperature and Water Consumption.

shown in this experiment, it is apparent that dairy cows should have free access to an adequate supply of good water. This is probably as necessary as a well balanced and adequate food supply.

LAWS OF SCIENCE GOVERN FOOD PRESERVATION

Enzymes and Bacteria Must Be Inactivated or Destroyed to Prevent Spoilage of Canned Goods

BY F. W. FABIAN, BACTERIOLOGICAL SECTION

New problems which require solution are constantly arising in every industry. This is especially true in the food industry. There are so many things that can happen to food before it is finally consumed that it has been necessary to place the whole industry on a scientific basis to insure a minimum of loss and to obtain a high grade product.

Microorganisms, which are enemies of the food industry, are omnipresent and cause far more trouble than any other factor involved. If it were not for them, it would be necessary only to heat food to inactivate the enzymes which are present. The products then would keep indefinitely without being placed in airtight containers. Food could be stored in open jars, crocks, or pails without danger of spoilage. However, the presence of microorganisms makes such storage impossible.

Significance of Enzymes

Few realize the scientific basis for food preservation. Why is it necessary to sterilize food products to keep them from spoiling? There are two real reasons. The first one is that it is necessary to inactivate the enzymes present. All foods contain chemical substances known as enzymes which cause food to deteriorate if it is allowed to stand for any length of time. The changes which occur in meat furnish a good illustration of the manner in which the enzymes act. If an absolutely sterile piece of meat is placed in a sterile container and sealed air tight, it will gradually putrefy although there are no microorganisms present. Eventually, all that will be left of the meat is water and the two gases, carbon dioxide and ammonia. The enzymes present in the meat would have completely changed it. This is the part that enzymes have in food deterioration. The conditions which must be present for them to work are heat and moisture.

Role of Microorganisms

Microorganisms are the other reason why foods must be preserved. They unquestionably play the most prominent part in food decay. There are three groups of them to be considered, molds, yeasts, and bacteria.

Molds affect foods with a low moisture content such as grain, flour, and sugar, and such dried foods as meat, fruits, and fish. They send out their long branches, known as hyphae, and are able to live in places where yeasts and bacteria would die. They grow on concentrated foods as jellies and jams. For this reason, it is best to preserve such foods

in sealed containers. One of the best ways of preventing mold growth is to exclude the air. Molds cannot grow in the absence of air but start growth on concentrated foods after the seal has been broken and the air permitted to enter. The mold spores have been present all the time but have not germinated because of an insufficient air supply.

Yeasts are minute microcopic plants that cause considerable damage to certain types of food as honey, cider, grape juice, or other fruit juices, and they may spoil such canned fruits as strawberries and raspberries. The conditions necessary for their growth are moisture and heat. They can grow for some time in the absence of air so that its lack is not a serious factor in preventing their growth. They are easily killed by heat, and, for foods properly heated and placed in air tight containers, they present no serious difficulty.

Bacteria present by far the most serious difficulty to the food industry. There are several reasons for this. In the first place, there are disease-producing bacteria which may find their way into food products. While there are disease producing molds and yeasts, they are few in number and are not as common as the disease producing bacteria. It is likewise true that the majority of disease producing bacteria are easily killed by heat. However, there are some kinds of bacteria in food which are extremely resistant to heat. The bacteria which is responsible for botulism, food poisoning caused by the growth of *Clostridium botulinum* in improperly canned or preserved foods, is one of the forms which is resistant to physical and chemical agents. Any satisfactory system of food sterilization should aim to kill *Clostridium botulinum,* the organism which causes botulism, just as any system of effective milk pasteurization aims to kill *Mycobacterium tuberculosis,* the organism causing tuberculosis.

The optimum conditions for the growth of the botulism organism are heat, moisture, a slightly alkaline reaction, and the absence of air. This organism is one of the most resistant forms of life known to science. It has been found that there is considerable variation in the heat resistance among different strains. The resistance to heat of 112 strains of spores, a stage in the life of a bacterium, was found to vary from 3 to 75 minutes at 221° F. Some strains were still alive after being heated five and one-half hours at 212° F., the temperature of boiling water. From this may be seen the necessity of a fundamental knowledge regarding the problems involved in safe canning.

Another type of bacteria universally present in food is the non-pathogenic group. This group contains by far the larger number of species and is responsible for the more common problems encountered in canning. If food is to be kept for any length of time, this type must be eliminated. It must always be kept in mind that food for man is likewise food for bacteria. Nutritious foods like milk and fish are the ones that spoil most rapidly. This is because they are readily decomposable by bacteria.

Type of Decomposition

Several factors determine whether a food will sour, ferment, or putrefy. Acid foods which contain carbohydrates, cider, grape juice and fruit juices in general, usually ferment. This change is alcoholic fermentation and takes place because the ideal conditions are present for yeasts which cause this type of fermentation. Due to their acid content these foods are easily sterilized.

Foods such as milk which have a reaction at or near the neutral point and which contain carbohydrates usually sour because the type of organisms which produce acid flourish under the conditions present in these foods.

Putrefaction occurs in protein foods low in carbohydrates. It is now generally recognized that, in general, bacteria will use carbohydrates in preference to proteins. This is known as the "protein sparing" phenomenon. That is why milk turns sour rather than putrefies under natural conditions.

Necessity for Canning Foods

From this brief discussion, some of the reasons for canning foods to preserve them may be seen. If it were not for the enzymes in food and for the microorganisms that are everywhere present, food would never decay. Fruit would fall from the trees and lie on the ground indefinitely. Vegetables would likewise keep indefinitely. The same is true of meat and other foods. Canning and preservation, therefore, is concerned primarily with destroying these two agents that cause the most serious damage.

Sealed containers are not only necessary to protect food against contamination but they likewise prevent the evaporation of moisture as well as the absorption of moisture which is equally injurious to some foods. Sometimes food placed in cans that are apparently air tight spoil due to the presence of a minute air hole. The reason for this spoilage is two-fold. As previously stated, organisms as molds, yeasts, and some bacteria require air for growth. If the canning has been done properly, practically all the air has been driven off so that these organisms can not grow even though they are alive inside the can. The second reason why such cans spoil is because, as the can cools, a vacuum is formed inside and air is sucked in through the small opening and with it microorganisms which cause the spoilage. It therefore follows that in order for canning to be successful all these factors must be considered. Anything short of this is ineffective and results in a loss. It likewise follows that those engaged in the canning and preserving industry should be familiar with the fundamental scientific principles involved so that they may apply them intelligently.

HARDY ALFALFA VARIETIES LEAD IN FIELD TRIALS

Seed of Southern Origin Fails to Produce Profitable Crop in Michigan Tests

BY H. C. RATHER AND G. F. WENNER, FARM CROPS SECTION

Previously reported[1] results of alfalfa variety tests conducted in Michigan, served to place alfalfa strains and varieties into three groups. The first and most desirable of these groups consisted of variegated

[1]Hardy Alfalfa Varieties Needed in Michigan, Cox and Megee, Michigan Quarterly Bulletin, Vol. X, No. 3, and Hardy Alfalfas Lead Michigan Over-State Tests, Rather and Wenner, Michigan Quarterly Bulletin, Vol. XII, No. 2.

types of alfalfa such as Hardigan, Grimm, Cossack, and Ontario Variegated. These are the alfalfa varieties recommended by the farm crops section of the Michigan Experiment Station for planting in Michigan.

Emphasis in these recommendations is placed on Grimm and Hardigan because seed of these varieties is most likely to be readily procurable in this state. Much larger supplies of dependable Grimm alfalfa seed are available than of any of the other variegated alfalfas but the production of Hardigan alfalfa seed is steadily increasing in Michigan and Utah.

The second group is made up of alfalfas of the common type, designated as to state of origin, and coming from states which have a severe winter climate such as Michigan, Montana, the Dakotas, Idaho, and Utah. Common alfalfa seed from these states, while not as good as Grimm, Cossack, or Hardigan, usually gives satisfactory crops and may be used when seed of the variegated types is not available. The most of this seed will come from Utah, Idaho, and Montana.

The third group includes those strains of alfalfa not adapted to Michigan. Among these types are Hairy Peruvian, Arizona Common, and seed from the Argentine. Such seed is to be avoided by Michigan farmers since it is almost certain to result in complete loss of the stand after the first or second winter.

Tables Give Yields For First Cutting

The tables which follow give the results of over-state alfalfa tests including yields for 1930. In all cases, the yields given are from the first cutting only and these serve as a basis for comparing the different strains rather than as an indication of the total yield which may be expected.

The tests at Gregory and Mosherville have each been harvested for six years and further records will not be taken. The test in Arenac County was reported last year[1], while those at Prescott, Bellevue, and Gaylord are reported for the first time, having passed through two winters. All of these tests tend to support the previous work in East Lansing and in over-state experiments which formed the basis for grouping alfalfa varieties in the manner described above. Thus far

JACKSON COUNTY TEST

Cooperator, O. R. Kintigh, Mosherville; Year Planted, 1924; Soil, Sandy Loam.

Variety	Yield of first cutting in tons of air dry hay per acre						
	1925	1926	1927	1928	1929	1930	Average
Hardigan (Michigan)	95	1 48	3.40	1 91	2.34	1.80	1.98
Cossack	1.05	1 37	2.92	1.73	2.32	1.68	1.85
Grimm (Michigan)	95	1.39	3.00	1 71	2.12	1.80	1.84
Common (South Dakota)	.	1.36	2.93	1.57	1.61	1.73	*1.84
Common (Michigan)	1.02	1.56	2.29	1.43	1.58	1.95	1.64
Liscomb	.73	1.38	2.60	1.20	1.82	1.46	1.53
Common (Utah)	.78	.88	1.95	1.43	1.42	1.35	1.27
Turkestan	.65	1.00	2.14	1.40	1.04	1.36	1.27
Argentine	.45	.72	.97	.69	.73	.89	.74

*Average for five years.

none of the over-state tests have ever pointed out a locality or soil in Michigan where the variegated types of alfalfa such as Grimm and Hardigan, was not superior to even the best of the common alfalfas. In most cases, there is but little difference between Grimm, Hardigan, and Cossack alfalfa so far as hay production is concerned. Such differences as are apparent point to a probable superiority of Hardigan alfalfa since this variety leads all of the older tests and is ahead in the second year of the Eaton County test.

Complete results to date are here given for six of the over-state alfalfa variety trials.

LIVINGSTON COUNTY TEST

Cooperator, H. O. Wasson, Gregory; Year Planted, 1924; Soil, Sandy Loam.

Variety	Yield of first cutting in ton of air dry hay per acre						
	1925	1926	1927	1928	1929	1930	Average
Hardigan (Michigan)	1 00	1 42	3 04	2 78	2 11	1 55	1 98
Cossack	96	1 38	2 92	2 63	1 94	1 82	1 94
Liscomb	80	1 30	2 77	2 48	1 92	1 59	1 81
Grimm (Michigan)	91	1 22	2 99	2 29	1 74	1 25	1 73
Common (Michigan)	91	1 34	2 80	2 33	1 74	1 08	1 70
Common (South Dakota)	65	1 16	2 63	2 25	1 60	1 18	1 58
Common (Utah)	69	1 25	2 38	1 21	1 23	69	1 24
Argentine	68	1 11	1 92	19	40	0	72

ARENAC COUNTY TEST

Cooperator, Ed. Donahue, Sterling; Year Planted, 1927; Soil, Sandy Loam.

Variety	Yield of first cutting in tons of air dry hay per acre			
	1928	1929	1930	Average
Hardigan (Michigan)	1 64	3 54	1 42	2 20
Grimm (Michigan)	1 70	2 64	1 32	1 89
Ontario Variegated	1 43	2 62	1 32	1 79
Cossack	93	2 82	1 51	1 76
Common (Michigan)	1 50	2 44	1.19	1 71
Argentine	47	0	0	.....
Arizona Common	0	0	0	...

OGEMAW COUNTY TEST

Cooperator, Ernest Bailey, Prescott; Year Planted, 1928; Soil, Clay Loam.

Variety	Yield of first cutting in tons of air dry hay per acre		
	1929	1930	Average
Grimm (Michigan)	85	1 62	1.24
Hardigan (Michigan)	70	1 57	1.14
Grimm (Idaho)	59	1 68	1.14
Cossack	68	1.54	1.11
Ontario Variegated	82	1.35	1.09
Common (Michigan)	62	1 35	.99
Argentine	26	1 00	.63
Arizona Common	.28	0	....

EATON COUNTY TEST

Cooperator, Bellevue High School, Bellevue; Year Planted, 1928; Soil, Sandy Loam.

Variety	Yield of first cutting in tons of air dry hay per acre		
	1929	1930	Average
Grimm (Michigan) ...	2 69	2 08	2 39
Hardigan (Michigan) .	2 51	2 19	2 35
Ontario Variegated ..	2 23	1 90	2 07
Common (Michigan)	2 18	1 74	1 96
Common (Utah)	2 02	1 65	1 84
Arizona Common	1 81	1 31	1.56

OTSEGO COUNTY TEST

Cooperator, Will Campbell, Gaylord; Year Planted, 1928; Soil, Sandy Loam.

Variety	Yield of first cutting in tons of air dry hay per acre		
	1929	1930	Average
Grimm (Lysle Berry, Cheboygan County)	2 75	2 35	2 55
Grimm (Michigan)	1 74	1 88	1 81
Hardigan (Irvin Cole, Cheboygan County)	1 95	1 52	1 74
Cossack. . .	1 27	1 98	1 63
Ontario Variegated.	1 23	1 93	1 58
Grimm (Idaho-Utah) .	1 27	1 74	1 51
Hardigan (Michigan)..	91	1 31	1 11
Common (Michigan) . .	81	1 20	1 01
Common (Utah) .	37	.62	50
Arizona Common	28	0	. .

STORAGE IMPROVES WATER CORE APPLES

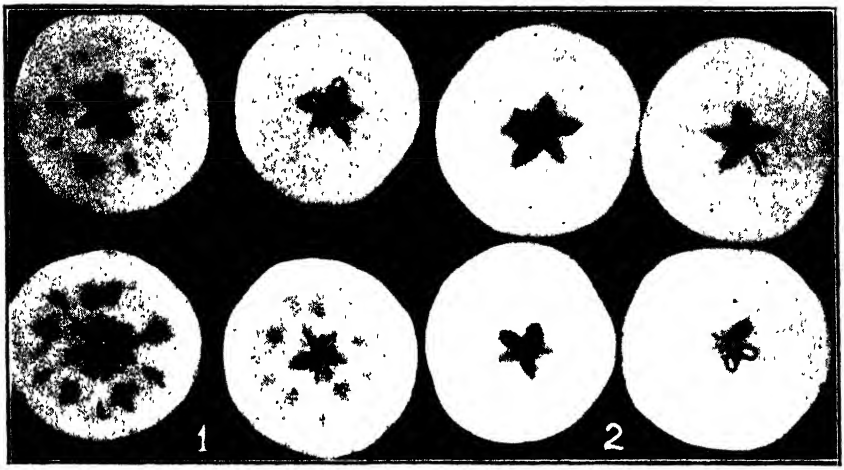
Apples Showing 90 Per Cent Water Core in October Were in Good Merchantable Condition Three Months Later

BY ROY E. MARSHALL, HORTICULTURAL SECTION

Certain varieties of apples were so badly affected with water core in 1929 that some buyers desired to cancel pre-harvest sales contracts. No attempt is made here to explain the prevalance of water core for that season other than to state that it evidently was due to some irregularity in moisture relation, not necessarily too much or too little moisture.

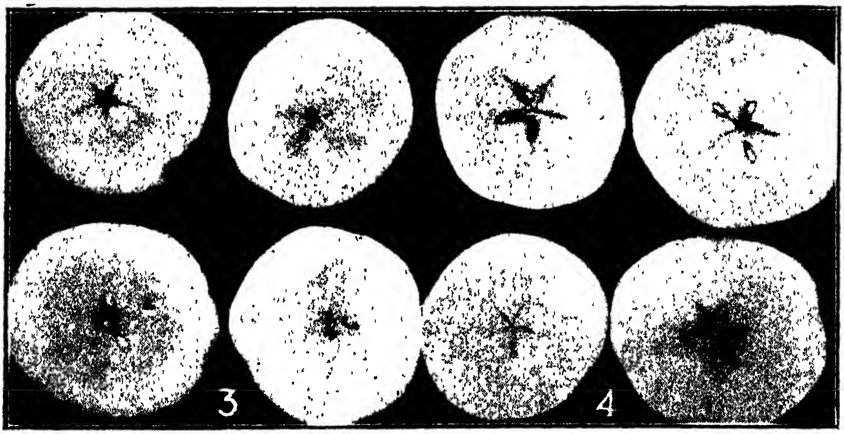
On October 23, the writer found as much as 90 per cent of the Delicious and from 50 to 75 per cent of the Wagener apples from certain orchards in Benzie and Leelanau counties showing considerable water core. The cross sections of random selected apples shown in Figures

1 and 3 furnish some idea of the prevalance, the extent, and the nature of the trouble with each of these varieties. The water core in Delicious seemed to develop about each of the 10 vascular bundles or core lines (figure 1). In bad cases, the water cored areas developing about adjacent core lines appeared to fuse and become conspicuous immediately about the core. In the Wagener apples, there was a tendency for the



Figures 1 and 2.

Fig. 1.—Random samples of Delicious apples showing water core condition October 23. Compare with Fig. 2. Figure 2.— Delicious apples from the same lot as those shown in Figure 1 after being held in cold storage until January 15. Water core has completely disappeared.



Figures 3 and 4.

Fig. 3.—Wagener apples photographed just after harvest (October 23) Compare the nature of the water core for this variety with that for Delicious, shown in Figure 1. Figure 4.—Wagener apples from the same lot as those shown in Figure 3 held in cold storage until January 15. Only three apples out of 22 showed any evidence of the trouble on this date.

milder forms of water core to develop as more or less continuous but irregular areas about the carpels, although in badly water cored apples the whole central portion of the fruit was involved (Figure 3). The involved areas in the Wagener presented a more glassy and smoother appearance than in the Delicious.

These apples were held in cold storage (32° F.) from October 23 until January 15 when the pictures for Figures 2 and 4 were made. At this time, not one of 50 remaining Delicious apples showed a trace of the trouble and only three of the remaining 33 Wageners showed water core. In other words, the water core had completely cleared up in the Delicious in less than three months time and the Wageners had changed from a condition of about 90 per cent water core apples in October to 90 per cent free from the trouble in January.

One bushel of tree run Delicious apples from each of three Benzie and Leelanau County orchards were expressed to the Experiment Station October 29. At the time they were picked, practically every apple showed more or less water core and many were badly affected. These apples were held in cold storage at East Lansing until January 15 when 40 apples were removed from the top and center of each bushel for cutting and examination. These apples were then classified into three groups as follows: Class 1, apples showing no water core; class 2, those showing a trace of water core but not enough to be noticed on cutting the fruits unless one were looking for some such trouble; class 3, apples having a noticeable or rather conspicuous amount of water core. This last class contained apples having water core spots larger than one-sixteenth inch. The largest water core spot found at this time measured about one-eighth by one-fourth inches in cross section.

Table 1.—Relative amounts of water core found in Delicious apples after 11 weeks storage. Practically all showed water core at harvest.

Orchard No.	Class 1	Class 2	Class 3
	None	Trace	Noticeable
	Per cent	Per cent	Per cent
1	87.5	5	7.5
2	42.5	40	17.5
3	62.5	25	12.5

These apples were examined by several pomologists and all agreed that the entire lot of apples was in a good merchantable condition on January 15 and that the amount of water core in Class 2 was of no consequence. From a practical point of view, it would appear that the water core was reduced from a condition of about 90 to 12 per cent in cold storage during the 11 week period. Expressed differently, water core cleared up in storage to the extent of about 75 per cent.

The balance of the apples from these three bushels of Delicious were held in storage until March 1 when an examination showed no evidence of water core in any of the apples.

The evidence clearly indicates that moderately water cored Delicious

and Wagener apples may be expected to return to an apparently normal and to a good merchantable condition when held in cold storage for the normal storage season of three to five months.

BEEF CALVES MAKE ECONOMICAL GAINS

Food Efficiency of Corn, Barley and Oats Compared

BY G. A. BRANAMAN AND G. A. BROWN, ANIMAL HUBSANDRY SECTION

This article gives the results of the seventh experiment at the Michigan Experiment Station in fattening baby beef calves for market. The Station Quarterly Bulletin for August of each year gives the report of the previous winter feeding trials.

The calves fed during the winter of 1929-30 were produced in Sanilac County, Michigan, from grade Hereford cows and purebred Hereford bulls. Equal numbers of steers and heifers were selected from a calf crop of approximately 90 head, with the object of securing a uniform lot of calves. They were taken directly from the cows and shipped to the Experiment Station feed lots early in November. The herd from which they came is an accredited tuberculosis free herd. All the calves were dehorned soon after arrival.

Fifty calves were divided into five lots, five steers and five heifers in each lot. The lots were as nearly equal as possible, from the standpoint of type, quality, condition, age, and weight. Three lots were used in this experiment and the other two lots in another experiment which will be reported when concluded at a later date. Individual weights were taken for three successive days at the beginning and at the close of the trial and every ten days during the feeding period.

Cost of Calves

The cost in the feed lots on November 26, including freight, feed, and all expenses, until started on feed on the above date, was $13.75 per cwt.

Object of Experiment

The object of this experiment was to determine the comparative feeding values of ground barley, shelled corn, and ground oats when each was fed with linseed cake, corn silage, and alfalfa hay.

Rations Fed

Lot 1. Ground barley, linseed cake, corn silage, alfalfa hay.
Lot 2. Shelled corn, linseed cake, corn silage, alfalfa hay.
Lot 3. Ground oats, linseed cake, corn silage, alfalfa hay.

The feeding period began November 26, 1929, and continued 190 days until June 4, 1930. The calves in each lot received all the silage they would clean up readily twice daily and alfalfa hay was kept before them in racks. A mixture of equal parts of bonemeal and salt was kept before them in boxes.

Approximately one pound of pea size linseed cake was fed to each six and one-half pounds of grain. About six pounds of this grain mixture per calf per day was fed during the first 60 days, eight and one-half pounds the next 60 days, 10½ pounds the next 40 days and 12 pounds the last 30 days.

The oat-fed calves in lot 3 were slower in cleaning up their grain than the other two lots. During the last few weeks, the corn fed calves cleaned up their feed more readily than the barley fed calves and were given a larger allowance towards the finish. However, this difference was very small.

Pigs Salvage Undigested Corn

Two 45 pound pigs were placed in the shelled corn lot and one pig in each of the other lots. Tankage was fed the pigs in each lot and

SUMMARY OF RESULTS

Nov. 26, 1929-June 4, 1930—190 days.

10 calves in each lot	Lot 1	Lot 2	Lot 3
	Ground barley	Shelled corn	Ground oats
	Pounds	Pounds	Pounds
Initial weight per calf	377 2	381 9	379 1
Final weight per calf	795 4	776 5	767 4
Total gain per calf	418 2	394 6	388 3
Average daily gain	2 20	2 08	2 04
Average daily ration:			
Ground barley	7 31		
Shelled corn		7 38	
Ground oats			7 31
Linseed cake	1 12	1 12	1 12
Corn silage	14 05	14 09	13 52
Alfalfa hay	4 22	4 21	4 26
Feed per cwt. gain:			
Ground barley	332.2		
Shelled corn		355 3	
Ground oats			357 7
Linseed cake	50 8	53 9	54 7
Corn silage	638 4	678 5	661 6
Alfalfa hay	191 9	202 6	208 6
Feed cost per cwt. gain	$9 13	$9 72	$9 78
Pork credit per calf at $10.00 per cwt	51	2 49	50
Feed cost per cwt. gain (crediting pork)	9 00	9 09	9 65
Initial cost in lots per cwt	$13 75	$13 75	$13 75
Initial cost in lots per calf	51 86	52.51	52 13
Feed cost per calf	38 17	38 36	37.96
Cost of calf plus feed cost	90 03	90 87	90.00
Necessary selling price in lots to break even (crediting pork)	11 25	11 38	11.67
Selling price per cwt. in lots	11 25	11 40	10 95
Selling price in lots per head	89 48	88.52	84.03
Returns per head above feed costs:			
Omitting pork	— 55	—2 35	—6.06
Crediting pork	— 04	.14	—5 56
Return per bushel grain fed	.72	.85½	35
Return per cwt. grain fed	1.50	1.51	1.10

Prices of feeds:
All grains $1.50 per cwt. No charges for grinding. (Ground barley 72c per bu., shelled corn 84c per bu., ground oats 48c per bu.,) Linseed cake $55.00 per ton, silage $5.00 per ton, alfalfa $12.00 per ton, tankage $3.75 per cwt., pork credited at $10.00 per cwt.

enough shelled corn was allowed to keep the pigs satisfied after obtaining what grain was left in the droppings. After deducting the cost of this extra feed, there was only a half dollar's worth of pork produced in the ground grain lots but there was $2.49 worth of pork to the credit of each calf in the shelled corn lot.

Many Factors Involved in Final Results

The barley-fed calves gained faster than the corn-fed calves on the same amount of feed, making 100 pounds gain for 59 cents less feed cost, not crediting feed saved by the pigs.

The pork produced in the shelled-corn lot was five times that in the ground barley lot, reducing the cost of gains to $9.09 per hundredweight in the corn lot and $9.00 per hundredweight in the barley lot.

The corn-fed calves were slightly fatter than the barley-fed calves and were valued 15 cents per hundredweight higher by a Committee representing Buffalo, Detroit, and Chicago markets.

Both lots of calves paid for their feed at these prices in spite of a selling value of $2.50 per hundredweight less than the cost price.

Oat-Fed Calves Not Finished

The oat-fed calves made slower gains on the same amount of feed, increasing the cost of gain and resulting in less finish on the cattle. The selling value was 45 cents per hundredweight below the corn-fed calves. They paid $1.10 per hundredweight for ground oats as compared with $1.50 for ground barley and $1.51 for shelled corn in lots 1 and 2. This lot of calves is being carried through the summer along side of two similar lots of calves that were wintered chiefly on roughage. These results testing different methods of wintering calves to be fattened for the late summer market will be published at a later date.

No Charge For Grinding

Had a charge of 10 cents per hundredweight been made for grinding the oats and barley, each oat-fed calf would be in debt another $1.40 or a total of $6.96. Each barley-fed calf would owe $1.44, while each calf fed shelled corn shows a credit of 14 cents above the cost of feed.

CONTROLLING THE COMPOSITION OF BUTTER

Give Formulae For Computing Amount of Water Needed to Give Desired Moisture Content

BY G. MALCOLM TROUT AND J. M. JENSEN, DAIRY SECTION

State and federal regulations require that butter shall contain not less than 80 per cent milk fat and shall contain not to exceed 16 per cent moisture. With these standards in mind, creamerymen strive to produce a uniform product which has the required amount of fat and not to exceed the standard amount of moisture.

Since it is very tedious and laborious to work excessive moisture out of butter, the practice is general of controlling the conditions of churning and working so that the original moisture content will be below the maximum standard of 16 per cent. The amount of water required to make up the difference is then computed and added to the butter which readily absorbs the added moisture upon further working.

The method commonly used for determining the amount of water to add, although giving fairly satisfactory results, shows a shortage of several pounds of butter from each churning. This method consists in multiplying the pounds of fat churned by the possible butter yield and by the difference between the actual moisture present and the amount of moisture desired. For example, when 1,000 pounds of fat are churned into butter which shall be 80 per cent fat, a 25 per cent overrun is possible, or $1000 \times 1.25 = 1250$ pounds of butter. When the initial moisture test shows the presence of 12 per cent moisture and 16 per cent is desired, then $(16 - 12) \times 1250 = 50.0$ pounds of water to add to the churning to bring the resulting butter up to 16 per cent moisture.

This method, however, yields results which are a trifle low and therefore represents a loss to the creameryman. This shortage is due to the fact that the initial moisture test, 12 per cent, represented the moisture content of the unfinished butter present in the churn which obviously was less than 1250 pounds, but was calculated as if the butter were finished. By assuming the presence of 1250 pounds of butter (this amount is not present because approximately 4 per cent of water is yet to be added) containing 12 per cent moisture, credit is given for more water in the unfinished butter than is actually present. Consequently, less water is added and the final moisture content is a trifle lower than that desired.

Several churnings were made at the dairy department, Michigan State College, to determine the possibility of a practical moisture control method by use of a formula which took into account the actual number of pounds of butter present when the first moisture test was made. The formula used, a modification of the Hunziker formula, follows:

$c - a = w$,

in which,

c = **calculated butter yield,** determined by multiplying the pounds of butterfat in the churn by the possible butter yield, $1000 \times 1.25 = 1250$ pounds butter containing 80 per cent fat.

a = actual pounds of butter in churn when the first moisture test was taken determined by dividing the sum of the fat, salt, and curd by the difference between 100 and the moisture test and multiplying the result by 100. This is illustrated as follows:

$$\frac{\text{butterfat} + \text{salt} + \text{curd}}{100 - \%\ \text{moisture}} \times 100 = \text{actual pounds of butter in churn.}$$

e. g. $\frac{1000 + 37.5 + 12.5}{100 - 12} \times 100 = 1193.18$ **pounds butter containing 12 per cent moisture.**

w = pounds of water necessary to add to bring moisture content up to desired standard, usually 16 per cent, e. g.

1250 — 1193.18 = 56.82 pounds water to add to churn.

In the above examples, 3 per cent salt, the amount which was desired in the finished product, was used in the calculation. When 80 per cent fat, 16 per cent moisture, and 3 per cent salt are present, the remaining 1 per cent is considered as curd. The amount of curd present in butter is generally calculated by taking the sum of the per cent moisture, fat, and salt present from one hundred.

The analysis of 13 churnings made at the Michigan State College Creamery in which the moisture added was calculated according to the above formula show the following composition:

Churning No.	Per cent fat	Per cent water	Per cent salt	Per cent curd
1	80 4	16 0	3.0	.6
2	80 2	16 0	3 0	8
3	80 3	16 0	3 0	7
4	80 5	16 0	2 88	.62
5	80 1	16 0	3 00	9
6	79 5	16 5	2 9	1 1
7	79 9	16 1	2 97	1 03
8	80 0	16 1	2 8	1 1
9	80 5	16 0	2 8	.7
10	80.6	15 9	2 7	.8
11	80 4	15 8	2 77	1 03
12	80 6	15 6	3 00	.8
13	79 8	16 2	3 06	.94
Average	80 21	16 007	2 91	.855
Composition desired	80 00	16 000	3 00	1.000

Irrespective of the method used for moisture control in butter, complete draining of the churn is very important. When the water to be added is calculated according to the above formula, the loose moisture in the churn must be well incorporated before the first moisture test is taken. The necessary water, which is added, should be equally well incorporated before making the final moisture test. Trials in which the churn was improperly and incompletely drained showed the initial moisture content to exceed 16 per cent. Under such conditions there is no control of moisture and the buttermaker is at the mercy of chance.

Salt was added at the rate of 3 per cent of the calculated butter yield when the churn was well drained and the butter was yet in a granular form. The calculated moisture necessary to bring the final moisture up to 16 per cent was added according to the trench method and worked into the butter until the inner surface of the churn door failed to show any droplets of loose water.

The average time of churning was approximately 44 minutes.

The Bulletins of this Station are sent free to such individuals as may request them. Address all applications to the Director, Agricultural Experiment Station, East Lansing, Michigan.

LIST OF AVAILABLE BULLETINS

Regular Bulletins—

262 Suggestions on Planting Orchards.
264 Second Report of Grade Dairy Herd.
267 Michigan Weeds (only to Michigan libraries and teachers. Others 25c).
277 Studies in the Cost of Market Milk Production.
281 Beautifying Farm Home Grounds.
284 Some Information and Suggestions Concerning the Use of Phosphorus.
286 Studies and Cost of Milk Production—No. 2.

Special Bulletins—

71 Studies in the Range and Variation of the Per Cent of Butter Fat in the Milk of Individual Cows.
83 Key to Orthoptera of Michigan.
90 Special Report of the Upper Peninsula Experiment Station.
91 Lime for Michigan Soils.
94 The Financial History of a Twelve-Year-Old Peach Orchard.
95 Muskmelon Culture in Michigan.
98 Vinegar.
100 Soy Beans.
101 Oats in Michigan.
106 Sugar Beet Growing in Michigan.
107 Diseases of Bees in Michigan.
110 Special Report of the Upper Peninsula Experiment Station.
111 Studies in City Milk Distribution.
120 The Microscopic Identification and Determination of the Specific Ingredients in Stock Feeds.
123 Second Growth Hardwood Forests.
124 The Colorimetric Hydrogen-ion Determination as a Means of Locating Faulty Methods at City Milk Plants.
125 Michigan Potato Diseases.
126 An Analysis of the Peach Variety Question in Michigan.
127 Nitrogen-Carrying Fertilizer and the Bearing Habits of Mature Apple Trees.
128 Sandy Soils of Southern Peninsula of Michigan.
130 The Clovers and Clover Seed Production in Michigan.
133 Fertilizers. What they are and how to use them.
134 Greenhouse Insects.
135 Seasonal Management for Commercial Apiaries.
136 The Muck Soils of Michigan.

138 Rural Highways.
139 Tourist Camps.
141 Profitable Pruning of the Concord Grape.
142 Grafting in the Apple Orchard.
143 Winter Pruning the Black Raspberry.
144 Spraying Dewberries for Anthracnose.
146 Air-cooled Storage for Apples.
147 Cherry Leaf Spot.
149 Eighty Winters in Michigan Orchards.
150 Emergency Hay and Pasture Crops.
151 Buckwheat in Michigan.
152 Sweet Clover.
153 Peppermint Growing in Michigan.
154 Hardy Shrubs.
155 The Mint Flea Beetle.
156 Investigation With Strains of Beans.
157 Celery Culture in Michigan.
158 A Suggested Bacteriological Standard for Ice Cream.
159 Production of Ice Cream With a Low Bacterial Count.
160 Why a Cull Apple Is a Cull.
161 Varieties, Locations, and Men in Apple Production.
162 Pruning the Red Raspberry.
163 Forest Planting in Michigan.
†164 Diagnosing Orchard Ills.
165 Management Methods in the Raspberry Plantation.
166 Studies in Orchard Management with Special Reference to Cherry Production.
167 Chicory Growing in Michigan.
169 Profit and Loss in Pruning Mature Apple Trees.
170 The Detroit Milk Market.
171 Farmers' Co-operative Buying and Selling Organizations in Michigan.
172 Farm Real Estate Assessment Practices in Michigan.
173 The Principal Bulb Pests in Michigan.
174 Spraying Calendar.
175 The Rural Cemetery.
176 The Uses of Cut Flowers.
177 The Significance of Soil Variations in Raspberry Culture.
178 Michigan Raspberry Diseases.
179 Forest Insurance and Its Application in Michigan.
180 The Soils of Michigan, Grayling Sand.
181 A Study of Town-Country Relationships.
182 Strawberry Growing in Michigan.
183 Common Pests of Field and Garden.
184 Size of Peaches and Size of Crop.
185 Roadside Marketing in Michigan.
186 Chrysanthemum Breeding.

†This is a popular bulletin on the identification of the more common disorders of tree fruits in Michigan. It should be found generally useful as a work of reference for practically everyone interested in the raising of fruit.

Because of the unusual expense of the color plates it will not be distributed to the entire mailing list but will be sent to those who specifically request it, upon the receipt of ten cents (coin or stamps).

187 What Makes Some Farms Pay.
188 Pollination of Orchard Fruits in Michigan.
189 The Marketing of Michigan Milk.
190 Oak Forests of Northern Michigan.
191 Barley for Michigan Farms.
192 Causes and Effects of Soil Heaving.
***194 The Use of Peat in the Greenhouse.**
***195 Maintaining the Productivity of Cherry Trees.**
***196 Combine Harvester Threshers in Michigan.**
***197 Oat Tests at the Michigan Experiment Station.**
***198 Combine Harvester Threshers in Michigan.**
***199 Studies in Swine Feeding, Parts I, II, III.**
***200 Hogging Off Corn.**
***201 The Influence of Sugar and Butterfat on the Quality of Ice Cream.**
***202 The Propagation of the Highbush Blueberry.**
***203 Spraying Materials and the Control of Apple Scab.**

Circular Bulletins—

34 More Wheat for Michigan.
47 Poisoning from Bacillus Botulinus.
48 Spraying for Hopperburn.
49 The Hessian Fly.
53 Standard Fertilizers for Michigan.
55 Lime requirement for St. Joseph County.
56 Lime Requirement for Cass County.
57 Lime Requirement for Calhoun County.
58 Lime Requirement for Berrien County.
59 Lime Requirement for Ottawa County.
60 Lime Requirement for Kalamazoo County.
61 Paying for Milk on a Quality Basis as a Means of Improving the Supply.
62 The Simplex Lime Spreader.
64 Simple Water Systems.
66 Tests with Sugar Beets.
67 The Cherry Maggots.
68 The Cherry Leaf Beetle.
69 Orchard Cover Crops.
70 The Present Status of the European Corn-Borer in Michigan.
71 Fertilizer Suggestions for Barry County Soils.
72 Fertilizer Suggestions for Berrien County Soils.
73 Fertilizer Suggestions for Cass County Soils.
74 Fertilizer Suggestions for Hillsdale County Soils.
75 Fertilizer Suggestions for Ingham County Soils.
76 Fertilizer Suggestions for Isabella County Soils.
77 Fertilizer Suggestions for Kalamazoo County Soils.
78 Fertilizer Suggestions for Livingston County Soils.
79 Fertilizer Suggestions for Macomb County Soils.
80 Fertilizer Suggestions for Muskegon County Soils.
81 Fertilizer Suggestions for Ottawa County Soils.
82 Fertilizer Suggestions for St. Joseph County Soils.

***Bulletins listed in bold faced type are recent publications of this Station.**

83 Fertilizer Suggestions for Van Buren County Soils.
85 Honey Vinegar.
87 Apple Maggot.
88 Fertilizer Suggestions for Calhoun County.
90 Cucumber Culture.
91 Arbor Day Programs for Rural Schools.
93 "Sting" on Apples.
94 Fleas and Bed-Bugs.
95 Feeding Minerals to Dairy Cattle.
96 Seed Corn Curing and Storing.
97 Cottage Cheese.
98 How to Make and Preserve Cider.
100 Michigan Farmers Tax Guide.
101 Cockroaches, Silver-fish, and Book-lice.
102 Farm Lease Systems in Michigan.
103 Prevention of Wind Injury to Crops on Muck Land.
104 Clothes-Moths and Carpet Beetles.
105 Sweet Corn.
106 Flies Commonly Found in Dwellings.
107 Mexican Bean Beetle.
108 Organic Matter in Berrien County Soils.
109 Organic Matter in Ingham County Soils.
110 Organic Matter in Kalamazoo County Soils.
111 Organic Matter in Ottawa County Soils.
112 Organic Matter in Van Buren County Soils.
113 Organic Matter in Calhoun County Soils.
114 Organic Matter in Livingston County Soils.
115 Organic Matter in Hillsdale County Soils.
116 Organic Matter in Macomb County Soils.
117 Distribution of Acid Soils, Muskegon County.
118 Distribution of Acid Soils, Jackson County.
119 Distribution of Acid Soils, Hillsdale County.
120 Distribution of Acid Soils, Ingham County.
121 Distribution of Acid Soils, Kent County.
122 Distribution of Acid Soils, Tuscola County.
123 Farm Milk Houses.
124 The Young Vineyard.
125 The Mint Flea Beetle.
126 Essentials of a Mulch Paper Laying Machine.
127 Pruning Young Fruit Trees.
128 Undulant Fever in Man and Abortion Disease in Cattle.
***129 Results of a Long Time Mineral Feeding Experiment with Dairy Cattle.**
***130 Cultural Methods in the Bearing Vineyard.**
***131 The Cherry Fruit-Flies.**
***132 June Beetles or White Grubs in Michigan.**
***133 Soft Scales Injurious to Deciduous Ornamentals.**
***134 Wood-boring Insects Which Attack Furniture and Buildings.**

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Quarterly Bulletins—

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Vol. XIII, No. 1, August, 1930.

Extension Series Bulletins—

2 The Babcock Test.
13 Oat Smut and Its Control.
17 The Stinking Smut of Wheat
19 Grasshopper Control.
20 Hotbeds and Cold Frames.
22 Effective Crop Exhibits.
23 Alfalfa.
24 Utilizing Poles and Timber in Farm Buildings.
25 Feeding Cull and Surplus Potatoes.
26 Swine Feeding.
27 The Kitchen Sink.
31 Capons.
32 Bull Pen and Safety Breeding Chute.
***33 Bigger Dairy Profits Through Dairy Herd Improvement Associations.**
34 Setting a Standard for Seed.
35 Curing Alfalfa.
37 Farm Kitchens.
38 Fertilizing Mature Orchards.
39 Orchard Grafting.
40 Pruning Black Raspberries.
41 Apple Storage.
42 Cherry Leaf Spot Control.
43 Dewberry Anthracnose Control.
44 Coming Through with Rye.

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46 Potato Price Trends.
47 Buying Fertilizers.
48 Poultry Housing.
49 Better Potatoes for Michigan.
50 Profitable Oat Production in the Upper Peninsula of Michigan.
51 Feeding for Eggs.
52 Care and Feeding of Growing Chicks.
53 Chick Diseases in Michigan.
54 Diseases of Adult Poultry.
55 Plowing for European Corn Borer Control.
56 Renting or Keeping Bees for Use in the Orchard.
57 Lime for Michigan Soils.
58 Culling the Farm Flock.
59 Methods of Control for the European Corn Borer.
60 Insect and Disease Control in the Home Orchard and Vegetable Garden.
67 Producing Sugar Beets.
68 A 10' x 12' Portable Brooder House.
69 A Simple Electric Water System.
70 Soil Management for Profitable Corn Production.
71 Value and Care of Farm Manure.
72 Wiring the Farmstead.
73 Barley, Cull Beans, and Potatoes as Feeds for Dairy Cattle.
74 The Fruit Bark-Beetle.
75 The Oriental Peach Worm.
76 Some Common Sucking Insect Pests of Evergreens.
77 The Tar-Paper Packing Case for Wintering Bees.
78 The Fruit Tree Leaf Roller.
79 Apple-Maggot.
80 Grape Root-Worm.
81 Growing Lima Beans for the Canning Factory.
82 Growing String Beans for the Canning Factory.
83 Growing Peas for the Canning Factory.
84 Growing Sweet Corn for the Canning Factory.
85 Dairy Goats.
86 Sheep Raising in the Upper Peninsula.
87 Silo Filling With Five Horse Power Electric Motor.
***88 Grinding Grain with Electric Power.**
91 Wheat Varieties for Michigan.
92 Beauty in Furniture Arrangement.
94 Better Bulls Increase Dairy Profits.
95 Why Cream Tests Vary.
96 Why Milk Tests Vary.
***97 Home Grown Feeds for Upper Peninsula Dairy Cows.**
***98 Essentials in Clean Milk Production.**
***99 Agricultural Outlook for Michigan—1930.**
***100 Arrangement of Barn Floor Plans—General Purpose Barn.**
***101 Standard Dimensions Used in Laying Out Barn Plans.**
***102 Arrangement of Barn Floor Plans—Dairy Barn Plan.**
***103 Portable Hog Cots.**
***104 Plan of Potato Storage Cellar.**

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Club Bulletins—

2 Potato Club Work.
3 Bean Club Work.
***5 Pig Club Work.**
7 Corn Club Work.
9a Clothing Club Work.
10 Canning Club Work.
12 Hot Lunch Club.
***15 Food Preparation.**
17 Dairy Club Work.
18 Poultry Club Project.
19 Forest Planter's Handbook.

Technical Bulletins—

21 How Contact Insecticides Kill.
32 The Transmission of Bacterium Abortus (Bang) to the New Born Calves Through the Ingestion of Milk.
33 A Study of the Presence of Bacterium Abortus (Bang) in Milk.
34 A Study of the Factors Which Govern Mating in the Honey Bee.
48 The Lecania of Michigan.
50 Rate and Extent of Solubility of Minerals and Rocks Under Different Treatments and Conditions.
59 Flat Sours.
60 The Influence of Manufacturing Operations on the Bacterial Content of Ice Cream.
61 The Relation of High Cellular Counts to Bacterium Abortus Infection of the Udder.
62 Some Physical and Chemical Properties of Several Soil Profiles.
64 The Salt Requirements of Marquis Wheat in Water Culture for the Vegetative Phase of Development.
65 Studies on a Non-Virulent Living Culture of Bact. Abortus Towards Protective Vaccination of Cattle Against Bovine Infectious Abortus (Bang's Abortion Disease).
66 The Significance of Bacterium Abortus Antibodies (Agglutinins and Complement-fixing) Found in the Sera of Calves at Birth or After Nursing.
67 Investigations on the Blackleg Disease of Potato.
68 Bacterium Pullorum.
69 The Fruiting Habits and Pruning of the Concord Grape.
70 The Nutrient Requirements of the Strawberry.
71 Growth of Lettuce as Influenced by Reaction of Culture Medium.
72 Potato Spraying and Dusting Experiments in Michigan.
73. Adsorption by Activated Sugar Charcoal.
74. Effect of Nutrient Conditions on Colloidal Properties of Certain Vegetable Crops.
75 Influence of Nutrient Supply on Earliness of Maturity in Cabbage.
76 Concentration of Materials and Rates of Application in the Control of Apple Scab.
77 The Influence of the Reaction of Cultural Medium on the Growth of the Strawberry Plant.

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78 The Effect of Certain Nutrient Conditions on Activity of Oxidase and Catalase.
79 Tests for Incipient Putrefaction of Meat.
80 Virus Diseases of Raspberries.
81 Storage and Transportational Diseases of Vegetables Due to Sub-oxidation.
82 Commercial Casein.
83 A Study of the Sanitary Significance of Air in Relation to Ice Cream.
84 The Clarifier and the Filter in Processing Milk.
85 Studies in the Etiology of Roup and Allied Diseases.
86 The Relation of Milk Solids Not Fat to Overrun and Quality of Ice Cream.
87 Paper Wrappers and Their Effect Upon Physical and Chemical Properties of Horticultural Products.
88 Investigations on Winter Wheats in Michigan.
89 Ultimate Effect of Hardening Tomato Plants.
90 The Breeding of Strains of A-Tester Yellow Dent Corn.
91 Taxes on Michigan Rented Farms.
92 A Study of the Cause of Honey Fermentation.
93 Observations on the Pathology of Bacterium Abortus Infection.
94 A Study of Gelatins and Their Effect on Ice Cream.
95. Studies in Flax Retting.
96 A Local Farm Real Estate Price Index.
97 Studies of the Overwintering and Modes of Infection of the Fire Blight Organism.
98 Further Studies on the Values of Non-Virulent Living Culture Vaccination of Cattle Against Brucella Abortus Infection.
99 Defective Graft Unions in the Apple and Pear.
100 The Differentiation of the Species of Genus Brucella.
101 A Test For Water-soluble Phosphorus.
***102 Keeping Qualities of Butter.**
***103 The Pathogenicity of the Species of the Genus Brucella for the Fowl.**
***104 The Physiological Effect of Ethylene Gas Upon Celery, Tomatoes, and Certain Fruits.**
***105 The Results of a Five Year Mineral Feeding Investigation With Dairy Cattle.**
***106 The Fruiting Habits and Pruning of the Campbell Early Grape.**

Nature of Publications—

Four series of publications are issued by the Experiment Station—Special, Circular, Technical, and Quarterly.

Special bulletins are of a popular nature, and deal with special lines of work.

Circulars are briefly and concisely written discussions of a popular nature.

Technical bulletins, as the name implies, are devoted to reports of scientific research and designed more especially for use of other investigators, instructors and students.

***Bulletins listed in bold faced type are recent publications of this Station.**

The Quarterly bulletin contains contributions by all sections of the Experiment Station. It is issued during February, May, August, and November of each year. Copies are sent to the entire mailing list. The Quarterly also contains a list of available bulletins.

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Single Copies of bulletins are for free distribution as long as the supply lasts. Quantities of bulletins may be secured at cost.

Requests for bulletins should be limited to those actually needed.

Bulletins are not intended to be used as text books in classes, but, upon application, libraries of colleges and public schools of Michigan will be supplied with a few copies for class reference.

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All applications for bulletins should be addressed to V. R. GARDNER, DIRECTOR, East Lansing, Mich.

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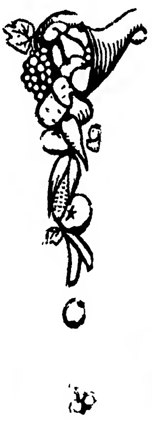
SUB-STATIONS

Chatham, Alger County, 780 acres deeded, G. W. Putnam, Director.
South Haven, Van Buren County, 10 acres rented; 5 acres deeded, S. Johnston, Superintendent
Graham Station, Kent County, 50 acres donated by R. D. Graham; 50 acres purchased, Walter Toenjes, Superintendent.
Dunbar, Chippewa County, Forestry Station, 577 acres deeded, Putnam Robbins, Superintendent.
Lake City Experimental Potato Farm, Missaukee County, 640 acres purchased or under contract, Ashley Berridge, Superintendent.
Kellogg Demonstration Farm and Wild Life Sanctuary, Kalamazoo County, 900 acres donated by W. K. Kellogg; C. M. McCrary, Superintendent.
Monroe, Monroe County, Corn Borer Station, 7½ acres rented.


THE

QUARTERLY BULLETIN

AGRICULTURAL EXPERIMENT STATION
MICHIGAN STATE COLLEGE
Of Agriculture and Applied Science



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CONTRIBUTIONS BY ALL SECTIONS OF THE
AGRICULTURAL EXPERIMENT STATION

MICHIGAN AGRICULTURAL EXPERIMENT STATION QUARTERLY BULLETIN
Vol. XIII, No. 2, November, 1930

PRODUCTION COSTS OF MICHIGAN BEANS STUDIED

Farmers in Twelve Counties Cooperate in Finding Actual Expense of Growing This Crop

K. T. WRIGHT, FARM MANAGEMENT SECTION

Over a 10 year period, the bean crop has been worth 17 million dollars annually to the farmers of Michigan. As a cash crop, it is exceeded only by potatoes and wheat. In the east central part of the State, navy beans account for about 60 per cent of the crop sales. Michigan farmers compete not only with those in other States but in other nations.

Brazil, India, Japan, Spain, Roumania, and the United States all produce large quantities of beans. Roumania and Japan are the chief exporters of beans that come into competition with Michigan pea beans. In the United States, Michigan produces about 35 per cent of the total crop, California 28 per cent, Colorado and Idaho each around 9 per cent, and New York 7 per cent. About 90 per cent of Michigan's bean crop consists of navy beans while California, with its varied conditions, produces Limas and Pinks more than any other varieties.. In Colorado, the Pinto bean is practically the only variety grown, and Great Northerns are the only important variety in Idaho. The beans of New York are largely navy and red kidneys. Michigan produces approximately 90 per cent of the United States' production of navy beans.

Since there is this competition in bean growing, it is necessary that the most efficient methods of production be determined. For this reason, the farm management department of this station is making a three year study of bean production. This study covers costs of production, effect of various practices upon costs and profits, relationships of the bean enterprise to the whole farm, as well as the relation between efficiency in production and efficiency in managing the entire farm business. This project was started in the spring of 1929 and was carried on in the following counties: Clinton, Genesee, Gratiot, Huron, Ingham, Midland, Newaygo, Oceana, Saginaw, Sanilac, Shiawassee, and Tuscola.

In determining the cost of production, man labor was figured at 35 cents an hour, horse labor at 15 cents per horse hour, two plow tractors at 90 cents an hour, and three plow at $1.25 an hour. The machinery cost was determined from an actual inventory and expense account with beans being charged a certain share based upon usage.

The manure charge was obtained by figuring the manure at two dollars a load after applied, then charging 40 per cent the first year,

30 per cent the second, 20 per cent the third, and 10 per cent the fourth year. The charge for green manure, the term applied to clover and sod that was plowed under, was based upon the recommendation of the soils department. The kind of crop plowed under, its growth, and the length of time between plowing and seeding were all taken into account.

The expense for fertilizer, threshing, taxes, and seed bought were taken from a record of the actual cost. Seed produced by the co-operating farmer was figured at market value. The heading "general farm expense" includes several items of overhead, such as personal taxes, miscellaneous work, part of the auto expense, fencing charge, and other miscellaneous items. Other records indicate that this charge usually amounts to about 10 cents for every hour of man labor.

Fig 1.—A good soil program and good cultural practices show results in this field even in a dry year.

The accompanying table shows the costs of production for both navy and red kidney beans. The navy beans were grown on soils that varied widely, so the farms were grouped on the basis of soil type. The Brookston soils are loams and clay loams, and are of a darker color and higher humus content than the Miami. They are generally level and require artificial drainage for high productivity. As a general rule, these soils do not need lime. The Miami soils are mostly loams of medium to high fertility on moderately friable clay sub-soils. They are somewhat rolling with good natural drainage, and retain a moderate amount of moisture. Applications of lime are quite beneficial as a rule. The sandy loams are quite variable but are generally of moderate fertility, acid in reaction, and may be either hilly or level.

The 133 farmers in the navy bean area that cooperated on this project in 1929 had an average of 25.5 acres in beans, table 1. The average

Table 1.—Navy and red kidney bean costs of production per acre—1929.

	Navy Beans						Red Kidney Beans	
Soil type or variety Number of farms	Brookston 68	Miami 52	Sandy 13	All Navy 133	Average of low cost group	Average of high cost group	Dark 15	Light 12
Growing Costs:								
Man labor	$5 07	$4 06	$5 28	$4 80	$4 38	$6 17	$5 55	$6 51
Horse labor	2 08	2 70	3 97	2 44	1 99	2 64	3 40	4 65
Tractor labor	2 98	2 61	3 00	2 88	2 27	2 98	75	35
Machinery	1 20	1 19	1 15	1 25	1 21	1 64	.50	.44
Seed	3 93	4 29	5 32	4 17	3 88	4 16	3 60	3 15
Barnyard manure	3 26	3 55	1 67	3 18	4 66	2 99	1 20	1 98
Green manure	83	96	91	88	50	1 08	64	75
Fertilizer	1 08	1 35	1 51	1 20	1 10	1 55	1 31	14
General farm expenses	2 35	2 13	2 54	2 30	2 08	2 78	2 65	2 77
Total	$22 87	$22 84	$25 35	$23 10	$22 07	$25 99	$19 60	$20 74
Harvesting Costs:								
Man labor	3 16	3 48	3 60	3 29	2 87	3 52	3 73	3 20
Horse labor	74	.87	1 10	81	79	96	50	48
Machinery	50	53	58	52	55	60	23	16
Threshing	1 32	1 43	1 21	1 34	1 71	1 25	86	87
Miscellaneous	30	03	12	22	04	13		
Total	$6 02	$6 34	$6 61	$6 18	$5 96	$6 46	$5 32	$4 71
Taxes on land	2 31	1 95	1 55	2 13	2 37	2 18	0 79	1 10
Interest on land	5 67	3 61	3 01	4 82	5 36	5 69	1 83	2 12
Total Cost	$36 87	$34 74	$36 52	$36 23	$35 76	$40 32	$27 51	$28 67
Income								
Beans (Value Dec 1)	47 13	38 99	29 51	43 10	62 62	41 12	30 35	25 60
Pods	1 31	1 38	1 14	1 31	1 53	1 27	1 10	84
Total Income	$48 44	$40 37	$30 65	$44 41	$64 15	$42 39	$31 45	$26 44
Profit or Loss	11 57	5 63	−5 87	8 18	28 39	2 07	3 91	−2.23
Value per bushel	$3 84	$3 75	$3 38	$3 83	$3 86	$3 98	$5 56	$4 90
Net cost per bushel	2 69	3 02	3 54	2 88	1 95	3 32	4 67	4 99
Acres in beans	30 8	18 5	25 4	25 5	28 1	28 1	9 9	13 0
Yield per acre (in bu)	13 2	11 0	8 3	12 1	17 6	11 7	5 7	5 6
Average pick (in %)	1 6	2 8	1 5	1 9	1 8	3 5		
Hours man labor, per acre	23 6	21 7	25 4	23 2	20 9	27 8	26 5	27 7
Hours horse labor, per acre	18 8	23 8	33 8	21 6	18 2	24 0	26 0	34 2
Hours tractor labor, per acre	3 6	2 8	3 3	3 4	2 5	3 4	8	5

yield was 12.1 bushels per acre, which was 3.9 bushels higher than the average for the entire state in that year and slightly higher than the 10 year average. The average total cost per acre for producing these navy beans was $36.23 for the 3400 acres included in the study. It cost these men $23.10 an acre for labor, power, machinery, seed, fertilizer, manure, and overhead up to harvest time. The difference of $13.13 was the cost of harvesting and the charge for the use of the land. The labor charge was figured at 35 cents an hour, which approximates the cost of hired labor, and no charge was made for management. The charge for man labor constituted over 22 per cent of the total cost on the average, while power and machinery made up nearly another 22

per cent. Charges for the use of land accounted for almost 20 per cent, seed and manure each slightly over 11 per cent, and fertilizer, threshing, overhead and miscellaneous made up the remaining 14 per cent. The net cost per bushel of beans produced by these 133 farmers, who averaged 12.1 bushels per acre, was $2.88 a bushel or $4.80 a hundred.

The cost of growing and of harvesting navy beans on Brookston and Miami soils, table 1, was practically the same but the land charge was higher on the Brookston. The yield per acre was 2.2 bushels higher on the Brookston soils so the profit was higher even though the total cost per acre was somewhat higher. The costs on sandy loams averaged about the same as on the Brookston or Miami soils, and the yield was lower so the income did not equal the charges. The last two columns in the navy bean section of this table show the average of two groups of 10 farms. The expense and income of bean production on farms of low cost per bushel can be compared with those of high cost.

Effect of Different Factors Upon Yields and Costs in Navy Bean Production

An attempt has been made to determine the influence of various practices upon yields and costs in bean production on the Brookston and Miami soils of the Navy bean area. The effect of green manure, barnyard manure, and commercial fertilizer upon the yield per acre and the cost per bushel is shown in Table 2. The relation between the yield per acre and the cost per bushel and the profit per acre were also studied and are shown in this table.

When making up this table, the farms were sorted on the basis of the amount of the factor being considered. For instance, in the case of the green manure tabulation, all farms plowing under no clover or sod were placed in one group, those having acre charges not to exceed $1.25 for this item were included in one group, and those over that

Table 2.—Effect of different factors upon yields and costs on Brookston soils—1929.

Factor	Number farms	Green manure per acre	Barnyard manure per acre	Com. fertilizer per acre	Total cost per acre	Income per acre	Profit per acre	Net cost per bushel	Yield per acre
Green manure									
None	18	......	$2 46	$ .60	$34.67	$42 96	$8.29	$2 83	11.8
To $1 25 per A.	27	$ .65	3 52	1 13	36.27	48.65	12.38	2 66	13.1
Over $1.25 per A.	23	2.00	3 59	1 46	39 56	53 04	13 48	2.60	14 7
Barnyard manure									
None	12	.74	....	.32	31 89	30.76	−1 13	3.52	8.8
To $3.50 per A	29	.76	1.99	1 23	35.45	48 86	13 41	2 56	13.3
Over $3.50 per A	27	.97	6.73	1.33	41.12	57.92	16 80	2.53	15.7
Fertilizer									
None.......	24	.49	2.56	....	34.62	43.32	8 62	2.83	11.9
To $1.50 per A.	18	1.06	2.84	.92	35.27	48.02	12 76	2.56	13.2
Over $1.50 per A.	26	1 04	4.31	2.38	40.02	53.87	13 85	2 64	14.6
Yield									
Up to 12.5 bu..	22	.54	.89	.68	32.07	33.16	1.09	3.35	9.3
12.6–16.0 bu...	25	1.12	3.99	1.40	38 02	51.83	13.81	2.62	14.0
Over 16.0 bu...	21	.83	5.76	1.16	41.78	66.20	24.42	2.22	18.0

amount in another group. Such items as costs, income, profit, and yields are shown in the tables, so that a detailed comparison can be made of the various groups.

This table on Brookston soils for 1929 shows that higher yields were secured on farms where a good growth of clover was plowed under, but it should be noted that larger amounts of barnyard manure and fertilizer were also used. In the case of barnyard manure, the yields were much higher where good applications were made but, as before, more commercial fertilizer was applied on the same farms. Applications of fertilizer appear to have also increased the yield and to have reduced the cost per bushel. In each of the three cases, the farmers who used the largest amount of the factor under consideration also used more of the other two so it is somewhat difficult to say just how much increase was due to each one. Special calculations have been made in order to approximate the influence of each factor, and it appears that a fair, spring growth of clover, valued at $2.00 an acre when used as green manure, increased the yield two bushel per acre on the average. Two dollars worth of barnyard manure seems to have increased the yield one and one-half bushels, and commercial fertilizer apparently gave the same increase in yield for each dollar expended.

A table similar to the table on Brookston soils was made up for Miami soils and was included in the mimeographed report which was returned to the cooperating farmers. This table shows that there were no apparent increases in yield on Miami soils from the use of manures or fertilizers in 1929. This is probably due to those soils being naturally drier than Brookston soils and consequently less likely to show increases in dry years like 1929, when July, August, and September rainfall was less than half normal. In considering these tables, it should be kept in mind that the figures are for only one year.

The effect of yield upon costs and profits is shown in the fourth group of this same table. The average yield of the high yield group is nearly double that of the low group, with the total cost per acre nearly one-third higher. The profit of the high yield group is $23.33 an acre more than in the low group. The cost per bushel decreased from $3.35 to $2.22 when the yield was increased from 9.3 bushels per acre to 18.0 bushels as an average for the two groups.

Even though the results from this bean study are for only 1929, which was considered a rather unfavorable bean year, it is thought that they are fairly typical and show normal tendencies and variations. The average yield obtained by the men who kept records in 1929 was slightly higher than the state average for the last 10 years. The records for 1929 show that it costs a little over $36 an acre on the average to produce navy beans, with a yield of 12 bushels per acre. The average price of navy beans for the past 10 years is $3.13 a bushel. If the 1929 costs are representative of the 10 year period, then it would require around 11 bushels to meet expenses. On the same basis, a yield of 15 bushels per acre would net approximately $10 profit per acre. This study indicates that the use of barnyard and green manures and commercial fertilizers on Brookston soils increased the yield sufficiently to more than twice pay for their cost. Little or no increase in yield resulted from the application of manures and fertilizers on Miami soils in 1929, due either to dry weather or to late plowing.

SIMPLE BURGLAR ALARM PROTECTS POULTRY

Farmers Having Power Line Service Can Install Inexpensive Alarm System

BY O. E. ROBEY, SECTION OF AGRICULTURAL ENGINEERING

Where electricity is available, it is comparatively easy to protect the chicken coop and other buildings with a burglar alarm. The one described below can be used where electricity is by a power line. It can be made from standard parts by anyone handy with electrical equipment. The essential parts of the system are:

1 110 volt to 6 volt transformer such as is used to ring doorbells (A—Figure 1).
1 Electric doorbell (G).
6 volt, 2 pole, "normally off" relay (D).
1 Enclosed double pole, single throw switch. Similar to Square D, Bulldog, and others (E).
Contact switches for doors and windows (B and C).
1 Dry cell.
Necessary insulated wire.

The cost of the necessary equipment will be approximately $15.

Figure 1 gives a schematic drawing of the hook up. Briefly, it may be described as follows: The transformer "A" reduces the voltage to make it safe to use for contact switches on windows and doors. The six volt line passes through the relay and extends to the buildings to be protected. The switches are placed on doors and windows so that when the doors are closed the circuit is complete through the transformer. If the circuit is complete, the magnet in the relay is energized and will hold the lever L away from the contacts M and N.

The relay should be mounted upside down as shown. It is usually necessary to add the lever L to a standard relay which should be made heavy enough so that the magnet will not lift the armature up but will hold it when raised by hand.

When a door or window is opened, the relay circuit is broken which causes the lever L to fall, closing the contacts M and N. This automatically turns on the yard lights and starts the bell to ringing. Turning on the lights will usually scare away the thief.

In case the thief again closes the door and completes the circuit, the level L is heavy enough so that it will not be raised by the relay magnet thus the yard lights will stay on and the bell will continue ringing. In the day time or when the alarm is not needed, the current can

be cut off from the transformer and also the bell circuit by opening switch E.

To put the alarm in operation again close switch E. The bell should start to ring, also the yard lights should turn on; this can be used for testing the circuits. Raise the lever L, and if the doors and windows where there are switches are closed, the lever should stay up.

The transformer, switch, bell, and relay can be mounted on a board or in a cabinet at a convenient place in the house. The bell or an additional bell may be placed in a sleeping room if desired. A battery is used for ringing the bell so that if the service wires to the house are cut the bell will still operate.

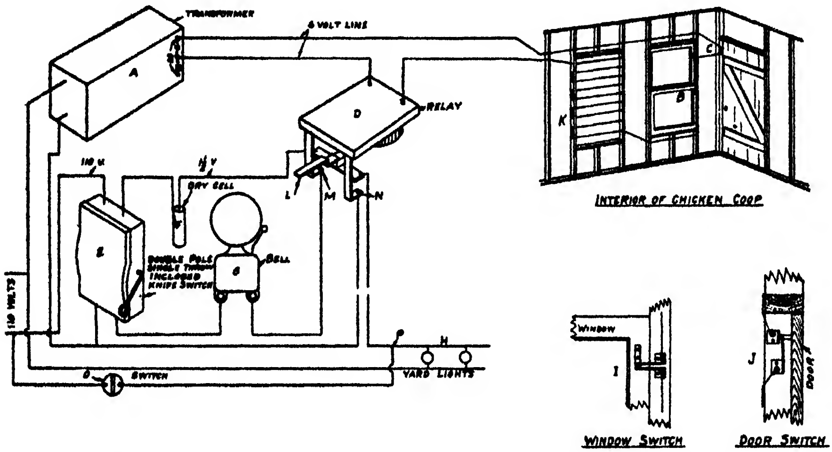

Fig. 1.—Diagram showing how the burglar alarm is wired and the parts used.

The present house switch for controlling the yard light is shown at O. By connecting the relay wire at P, the burglar alarm wiring will not interfere with the operation of the yard lights by the present switches.

The door and window switches are merely a brass plate and a piece of spring brass. The brass plate is attached to the door casing and the spring brass to the door in such a manner that when the door is closed the two make contact. A similar switch can be used on the windows. Open windows may be protected by wires threaded across them as shown at K, Figure 1, the wires should be attached so that they cannot be removed except by breaking and should be close enough together so that a man cannot crawl between them. These wires should be put in series with the switches.

BEEF CALVES USE ROUGHAGE EFFICIENTLY

Silage and Legume Hay Make Good Wintering Ration

BY G. A. BRANAMAN AND G. A. BROWN, ANIMAL HUSBANDRY SECTION

An article in the August number of the Quarterly Bulletin gave the comparative feeding values of farm grains when beef calves are being fattened for spring market. Two additional lots of 10 calves each were selected and started on feed November 26, 1929, at the same time as the three lots of fattening calves. Lot 3 was continued through both experiments. These were Michigan grown grade Herefords, dropped in April and May, and shipped directly to the College feed lots when weaned from the cows early in November.

The five lots of calves were selected as nearly alike as possible and each calf was graded by the official committee from the U. S. D. A. and the cooperating State Experiment Station. Five heifers and five steers constituted a lot.

Objects of Experiment

Answers to the following questions were sought in planning this experiment:

(a) Can calves that are to be fattened for fall market be wintered on roughage?

(b) How much grain feed is necessary to make finished yearling cattle?

Rations Fed

Each lot had free access to fair quality, first cutting alfalfa hay at all times. A mixture of equal parts granulated salt and bone meal was supplied.

Corn silage was fed to all lots until the last 44 days. The calves in Lot 5 did not receive all the silage they wanted the first four months.

Lot 3 was fed a moderate ration of ground oats the first four months, which was increased later in the period, and a full feed the next 70 days. At the finish of an experiment on June 4, comparing this lot with others fed barley and corn, the oat ration was changed to one of shelled corn.

Approximately one pound of pea size linseed cake was fed with each seven pounds of grain to all lots except Lot 4 during the first period.

The calves in Lot 4 received a very small quantity of grain the first four months, just enough to keep them holding their own or gaining slightly in finish. The amount was increased later to a full feed.

In Lot 5, no grain was fed the first four months. A liberal feed was given the next 70 days and a full feed the last 74 days.

Feed Prices

The following prices of feeds were used as approximating Michigan farm prices during the time of the experiment.

All grains, as fed, $1.50 per hundredweight, no charge for grinding; linseed cake $55; silage $5; alfalfa $12; tankage $75 per ton. Pork was valued $10 per hundredweight.

Pigs Salvage Some Feed

One pig in Lot 3 apparently got very little from the droppings when ground oats were fed. Considerable corn and tankage was necessary to keep it satisfied even when the calves got all the oats they would eat. No pigs were put in Lots 4 and 5 until the second period. When shelled corn was being fed, two pigs were kept in each lot. Some extra corn and tankage was fed as needed and their cost was deducted from the pork sales. The remaining pork returns were given credit in reducing the feed bill of the cattle.

Table 1.—Results of first period—Nov. 26, 1929-March 26, 1930—120 days.

	Lot 3	Lot 4	Lot 5
Number calves per lot	10	10	10
Average daily ration	Pounds	Pounds	Pounds
Ground oats	5 99		
Ground corn		2 33	.
Linseed cake	90	.06	... ..
Corn silage	13 33	17 07	15 53
Alfalfa hay	3 75	5 14	7 20
Average initial weight	379 1	381 4	382 1
Average final weight	610 4	548 7	519.3
Average daily gain	1 93	1 39	1 14
Cost per cwt. gain (crediting pork, Lot 3)	$8 73	$7 90	$7.18

Grain Increases Cost

A check on the feed consumption and the gains produced during the first 120 days of feeling gave a decided advantage to the calves fed on roughage alone. Although the calves in Lot 5 did not get all the silage they would have eaten, they gained 1.14 lbs. per day at a cost of $7.18 for 100 lbs. gain.

The small quantity of grain fed to Lot 4 increased the gains one-fourth pound per day but the cost also went up 72 cents per hundred pounds of gain. These calves looked to be in slightly better flesh than those in Lot 5.

The liberal grain feed in Lot 3, although not a full feed, increased the gains to 1.93 pounds per day and the cost also increased to $8.73 per 100 pounds gain, a difference of $1.55 above Lot 5. The weights were 91 pounds more per calf than those in Lot 5 and 61 pounds above Lot 4.

Table 2.—Results of second period—March 26-June 4, 1930—70 days.

	Lot 3	Lot 4	Lot 5
Average daily ration	Pounds	Pounds	Pounds
Ground oats	9 58	.	.
Shelled corn	. . .	4.23	5.78
Linseed cake	1 50	.60	83
Corn silage	13 86	24 80	20 06
Alfalfa hay	5 14	6 36	7 11
Average final weight	767 4	693 0	683 8
Average daily gain	2 24	2 06	2 35
Cost per cwt gain (crediting pork)	$11 01	$8 08	$7 89

Roughage Calves Respond to Grain Feed

The liberal feeding of shelled corn with linseed cake to Lot 5 during the second period caused the daily gains to double. Their roomy middles allowed them to use still larger quantities of silage and hay. The cost of gain still remained below $8.00.

Slower increases of corn in Lot 4 left the two lots about equal in weight and finish at the end of 190 days feeding.

The gains in Lot 3 were intermediate between the other lots during this second period although these calves ate considerably more ground oats than the others ate shelled corn. The costs were decidedly higher. A selling value in the lots of $11.15 per hundredweight would pay the feed bills in Lot 5, and $11.16 in Lot 4, whereas Lot 3 must sell at $11.67 per hundredweight to break even. The calves were valued June 4 by market experts at approximately these differences between lots, $10.40 in Lots 4 and 5 and $10.95 in Lot 3. No lot carried enough finish for choice cattle. Each calf in Lot 3 owed $5.56 on the feed bill; in Lot 4, $5.25; and in Lot 5, $5.11.

The beef market had declined materially since these calves were bought in the fall at a cost of $13.75 in the feed lots.

Table 3.—Results of third period—June 4-Aug. 17, 1930—74 days.

	Lot 3	Lot 4	Lot 5
Average daily ration	Pounds	Pounds	Pounds
Shelled corn	13 04	12 15	12 62
Linseed cake	1 74	1 74	1 74
Corn silage	5 77	6 80	7 09
Alfalfa hay	6 80	8 34	8 19
Average final weight	919 1	875 4	879 7
Average daily gain	2 06	2 46	2 65
Cost per cwt. gain (crediting pork)	$13 50	$11 19	$10 75

Short Fed Calves Forge Ahead

During the summer, the full feeding of shelled corn and linseed cake to the calves in Lots 4 and 5 which were wintered chiefly on roughage resulted in faster gains and cheaper gains than in the case of Lot 3, which had been fed grain since November. Lot 4, which received a

little grain during the winter, dropped slightly behind Lot 5 during this finishing period, but gained faster and cheaper than Lot 3.

Table 4.—Summary of experiment—Nov. 26, 1929-Aug. 17, 1930—264 days.

	Lot 3	Lot 4	Lot 5
	Pounds	Pounds	Pounds
Total gain per calf	540 4	494	497 6
Average daily gain—264 days	2 05	1 9	1 9
Total feed per calf			
Ground oats	1389		
Corn	965	1475	1338
Linseed cake	341	178	187
Corn silage	2996	4287	3793
Alfalfa hay	1313	1679	1968
Total feed cost per calf	$60 05	$47 81	$46 50
Pork credited per calf	2 08	2 50	2 61
Feed cost per cwt gain	11 11	9 68	9 35
Feed cost per cwt. gain (crediting pork)	10 73	9 17	8 82
Initial cost in lots per cwt	$13 75	$13 75	$13 75
Initial cost per calf	52 13	52 44	53 41
Cost of calf plus feed cost (crediting pork)	110 10	97 75	97 30
Necessary selling price (crediting pork)	11 98	11 17	11 06
Selling price in lots	9 65	9 05	9 30
Loss per head	21 41	18 53	15 49

In order to pay the feed bills, August 17, 1930, at the close of the entire 264 day feeding period, the necessary selling price in the feed lot was 92 cents per hundredweight lower in Lot 5, the short-fed lot, than in Lot 3, the long-fed lot. The difference in market value, however, as determined by a commission man and a buyer from the Detroit market, was only 35 cents per hundredweight, making the loss per head $6 less in Lot 5 than in Lot 3.

Lot 3 was graded choice to prime and Lots 4 and 5 good to choice by the official committee.

The calves in Lot 4 lacked the uniformity of those in Lot 5 and were valued 25 cents per hundredweight lower. If the values had been the same, they would have been on practically an equal basis.

Lots 4 and 5 consumed considerably more roughage in the form of silage and hay and decidedly less grain than Lot 3.

This experiment will be repeated before drawing positive conclusions.

CONTROL METHODS FOR SQUASH VINE BORER GIVEN

Spraying and Clean Up Measures Prevent Insect From Seriously Injuring Crop

BY RAY HUTSON, SECTION OF ENTOMOLOGY

Usually in July, squash and pumpkin plantings begin to show vines which are withered and discolored near the roots.

The trouble appears to spread and may cause heavy losses in severe cases and does cause annoying losses in all cases. If affected vines are split open in the withered region, small, worm-like boring caterpillars are exposed. These are the larvae of the squash vine borer, *Melittia satyriniformis,* and the apparent spread of the trouble from plant to plant is due to the comparatively extended egg-laying period of the adult moths and to their habit of laying only a part of the eggs on one plant.

The small, oval, somewhat flattened, brownish eggs are one-twenty-fifth inch long. Each egg is separately glued on the vines, usually toward the base of the plant. The period of egg laying occurs between June 25th and July 15th. About one week after the egg is laid, it hatches into a minute worm-like caterpiller which burrows into the stem.

By the time the plants begin to show signs of infestation the caterpillars are one-half inch to one inch long and one-fourth inch thick. Close examination discloses a brownish head, six slender legs on the section just back of the head, and five pairs of short fleshy leg-like outgrowths on the posterior end.

After about one month, the larvae enter the soil an inch or two, make a dirt covered cell, and, as a rule in Michigan, remain in the soil until the following June. The adult moth has brownish front wings and transparent hind wings and flies in the day time. It is one to one and one-half inches across the wings.

These high points in the life history and habits of the squash vine borer indicate the more reasonable points of attack. Experience in several states shows it is readily possible to locate the small brownish eggs upon the vines if search is made during the latter part of June and to gain control of squash vine borer if the vines are kept thoroughly covered for one month with an application of one and one-half pounds of arsenate of lead to fifty gallons of 4-4-50 Bordeaux. The cost of this treatment varies in proportion to the number of times the weather necessitates spraying to maintain coverage. If no more than four applications are required, the cost will be around $2.50 to $3.00 per acre for material. The control effected by this method varies from 80 to 100 per cent, depending upon the timeliness and thorough-

ness of application. The fact that there is but one generation per year and that the larvae are confined to the plant on which the eggs are laid makes even the lower figure a very satisfactory control.

Since these insects pass the larger part of the year just below the surface of the ground, planting a cover crop or working the ground after the infested crop is harvested, together with thorough working of the ground in the spring, reduces the over-wintering forms materially. Another useful control measure is that of destroying the infested vines as soon as the crop is gathered.

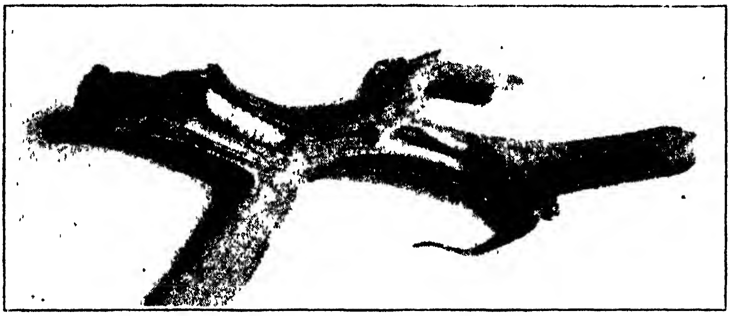

Fig. 1.—Squash-vine borer in tunnel in squash-vine.

The person with a few hills of squash or pumpkin can secure a measure of relief by throwing dirt on the vines where the leaves come off, thus inducing the plants to root in several places. It is also a good practice in small plantings to split the stems of infested plants and to remove the borers present. Otherwise, they will travel down the stem to new locations.

ARSENICAL SOMETIMES INJURES PEACH TREES

Care in Mixing and Applying Sprays Reduces Foliage Damage Without Affecting Insect Control

BY W. C. DUTTON, HORTICULTURAL SECTION

The peach in Michigan is subject to injuries of many kinds and the majority of growers are familiar with most of them. One trouble, however, that often is not correctly diagnosed or even not recognized by many growers is arsenical injury. Arsenate of lead used alone or in combination with other materials applied as spray or dust during the growing period may cause severe injury to leaves, bark and wood

and even to the fruit. Injury may appear within a week or 10 days after application or it may not become evident for several weeks.

Characteristics of Injury

Injury to leaves appears first as red spots in the leaf tissue. This tissue soon dies, turns brown, and may drop out in the form of irregular shot-hole spots. Injured leaves usually turn yellow and drop, and it is not at all uncommon for most of the leaves covered by an injurious application to fall. It might follow, then, that the spur type of growth would be almost completely defoliated and that all the leaves on shoots developed at the time of the application would drop.

Injury to the bark and wood often occurs on the current season's growth at the point where leaves are attached and around the new buds. Injury may also occur at the base of the current year's terminal growth in the roughened area that is usually present at that point. Another point where injury is commonly found is at the base of spurs or shoots on wood of the previous season or even on older wood. Large areas of bark may be seared or killed. In some instances, this injury goes to the cambium layer or it may be only superficial. When only superficial, the injured area may constrict the branch as by a band. This seared bark may later crack and split and excessive enlargement occur. When the injury goes to the cambium there is a definite girdling and during late summer such branches show yellowing and rolling of the leaves and reddening of the bark and may break down. Gum exudations occur in many instances.

Effects of Injury

The defoliation that may follow arsenical injury will result in small fruit of very poor quality in those parts of the tree where defoliation occurs and there is undoubtedly a general effect on the whole tree. The laying down of fruit buds is undoubtedly checked where defoliation occurs and the deep seated injuries to bark and wood weaken limbs and interfere with the movement of water and plant foods in the tree.

Reducing Arsenical Injury

Much is yet to be learned about arsenical injury and its prevention but there are certain precautions that may well as followed.

1. Use arsenate of lead as few times as is possible and still obtain satisfactory control. Some orchards may not need an arsenical.
2. Spray or dust thoroughly but lightly. Never drench a peach tree with spray or apply dust heavily.
3. Use low concentrations of lead arsenate in both dusts and sprays.
4. Lime should always be used in connection with lead arsenate on peach trees.

Specific instructions as to the time to spray or dust and the amounts and combinations of materials to use may be found in the current issue of the Spraying Calendar, published by Michigan State College.

CONIFERS VARY IN RAPIDITY OF GROWTH

Western Yellow Pine, Eastern White Pine, and Norway Spruce Need Different Spacing in Planting

BY R H WESTVELD, FORESTRY SECTION

Whether trees are planted for commercial plantations or windbreaks, the rate at which they develop is important, not only in determining their relative value for various purposes, but also the spacing distance that may be desirable in planting.

Proper spacing of the trees in a commercial plantation is especially important because of its bearing on the future treatment of the stand, such as the making of thinnings. The date of thinning can be postponed or hastened very materially by widening or narrowing the spacing. Under conditions where small trees have no market value, it is often desirable to make thinnings at as late an age as possible in order to realize a profit on the operation.

In windbreak planting, proper spacing is equally important in order that an effective barrier against the wind will develop at an early age. Some knowledge of height growth is important in this connection for the same reason.

A series of plantations at the College throws some light on these problems. All of these plantations were set out in 1914 on a sandy slope which is more or less uniform throughout the three plantations. Because of the difference in moisture conditions from the bottom to the top of the slope, the site is divided into two classes, the lower slope and the upper slope.

The trees were spaced four feet apart both ways. The following classes of stock were used: western yellow pine, 2 year seedlings; eastern white pine, 6 year transplants; and Norway spruce, 4 year transplants.

The average height and diameter of the trees in the fall of 1930 is given in the following table.

Of the three species, eastern white pine has attained the greatest height but western yellow pine has attained the largest diameter. The difference in height between these two species is more apparent than real because the western yellow pine plantation is actually younger than the eastern white pine as there was a difference of four years in the age of the stock which was planted. On a comparative basis, then, the difference in diameter is actually greater than the figures in the table indicate. The largest trees totaled were: western yellow pine, 6.9 inches; eastern white pine, 7.2 inches; Norway spruce, 4.9 inches.

The growth, both in height and in diameter, has been consistently

The height and diameter of western yellow pine, eastern white pine, and Norway spruce on two sites 16 years after planting.

	Western Yellow Pine	Eastern White Pine	Norway Spruce
Total height in feet:			
Lower slope	21.7	23.3	21.8
Upper slope	18.7	19.6	11.1
Diameter at breast—height in inches:			
Lower slope	4.4	4 0	3 0
Upper slope	4 1	3.4	2.1

better on the lower than on the upper slope for all species. However, the difference is less pronounced for western yellow pine than for eastern white pine and Norway spruce. This is to be expected since the former species grows naturally on very dry sites and has probably become so adjusted to these extremely dry conditions that improved moisture conditions do not increase the rate of growth proportionately. The Norway spruce has done very poorly on the dry upper slope.

In a visual analyses of these plantations, other differences are noted that are not brought out by the figures given above. The western yellow pine, consistent with its large diameter, has developed a wider spreading crown than the other species. The trees are now crowding each other to such an extent that some of the trees have already died naturally and, especially on the lower slopes, a thinning is quite necessary. At the other extreme, the Norway spruce has developed narrow crowns which are not as yet crowding each other. This plantation will not need a thinning for at least five years. The eastern white pine is intermediate in crown development. The rate of development corresponds with the degree of tolerance of these species, the yellow pine being the least tolerant, and the Norway spruce the most tolerant. On this basis, it can be seen that for commercial planting different spacing for each of the species and for different soils, dependent upon favorableness for growth, would work to advantage. The thinning in western yellow pine could be postponed until the trees were of a more valuable size if a wider planting spacing were used. In windbreak planting, where the development of a closed canopy at an early age is desirable, spacing should be closest for the more tolerant species.

BARLEY SUBSTITUTED FOR CORN IN POULTRY RATION

Will Determine If Its Use As Growing Feed Affects Egg Yield Afterwards

BY J. M. MOORE, POULTRY SECTION

Corn has always been an important ingredient of the poultry ration. Most poultry rations, whether they are starting mashes, growing mashes, or laying formulae, contain a high percentage of this grain. Many sections of Michigan, because of climatic limitations, cannot raise their own corn, and have to import it with freight expense added to its cost. Corn borer infestation in other sections have made the corn crop a greater problem than in former years, and, for these reasons, it is important that the Michigan poultrymen find suitable substitutes for corn in the poultry ration.

Poultry feeding experiments with barley were begun November, 1928, at the Michigan Station. A comparison was made in the laying ration by replacing the corn of the ration with barley. The results obtained were satisfactory, the hens which were fed barley produced eggs as economically as the ones fed corn. This work is being continued with laying hens, and this year a study of barley as a substitute for corn in the starting and growing ration of baby chicks was made.

One hundred eighty chicks in one brooder house and 200 baby checks in another were used in this experiment. Both lots of chicks were single comb white Leghorns and were hatched in the same incubator on April 21. On April 23, they were put out in the brooder houses and started on two different rations. Pen 1 was fed a barley ration while pen 2 was fed a corn ration.

Starting Mash Fed In Experiment

Pen No. 1—Starting Mash

55# ground barley
5# alfalfa leaf meal
20# flour middlings
10# dried milk
5# meat meal
4# steamed bone meal
1# salt

Pen No. 2—Starting Mash

60# ground yellow corn
20# flour middlings
10# dried milk
5# meat meal
4# steamed bone meal
1# salt

It will be noticed that there is a slight difference in the starting mash fed to pen 1 and to pen 2. The ration for pen 1 contains 55 pounds of ground barley, and 5 pounds of alfalfa leaf meal, while the

mash in pen 2 consists of 60 pounds of ground yellow corn and no alfalfa leaf meal. The reason for adding the alfalfa leaf meal to the mash for pen 1 was to supply Vitamin A, which yellow corn contains and which barley does not supply in sufficient quantities. The chicks were fed for four weeks on all-mash starter which was before them in open hoppers at all times. At the beginning of the fifth week, scratch grain was added to the rations and the starting mash was gradually changed over to the growing mash so that at the end of the seventh week the chicks were receiving both the growing mash and the scratch grain in open hoppers. Up until they were 20 weeks old, when the pullets were put in the laying house, the growing mash and the scratch grain was available to the birds at all times.

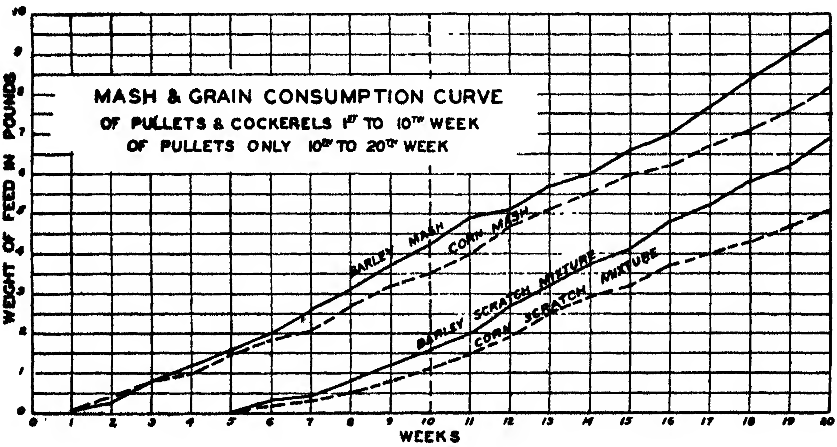

FIG. I

Growing Rations Fed In Experiment

Pen No. 1.—Growing Mash

20# ground barley
20# bran
20# flour middlings
15# ground hulled oats
10# ground oats
5# meat meal
5# dried milk
4# steamed bone meal
1# salt

Scratch Grain

50# whole barley
50# whole wheat

Pen No. 2.—Growing Mash

20# ground yellow corn
20# bran
20# flour middlings
15# ground hulled oats
10# ground oats
5# meat meal
5# dried milk
4# steamed bone meal
1# salt

Scratch Grain

50# medium cracked corn
50# whole wheat

As soon as the chicks were old enough, they were given an outside run. The size of this run was increased until they had a yard 30 by 30 feet in area. Weekly records were kept of feed and individual chick weights. During the hot summer weather, artificial shade was provided for the chicks outside the brooder house.

The mortality in the two pens was similar. Pen 1 lost 17 per cent from the time of hatching until maturity, while pen 2 lost 15 per cent. The difference of 2 per cent may be explained by the fire going out one night in pen 1, which caused a heavier mortality. No outbreak of coccidiosis was experienced in either pen and the chicks grew and

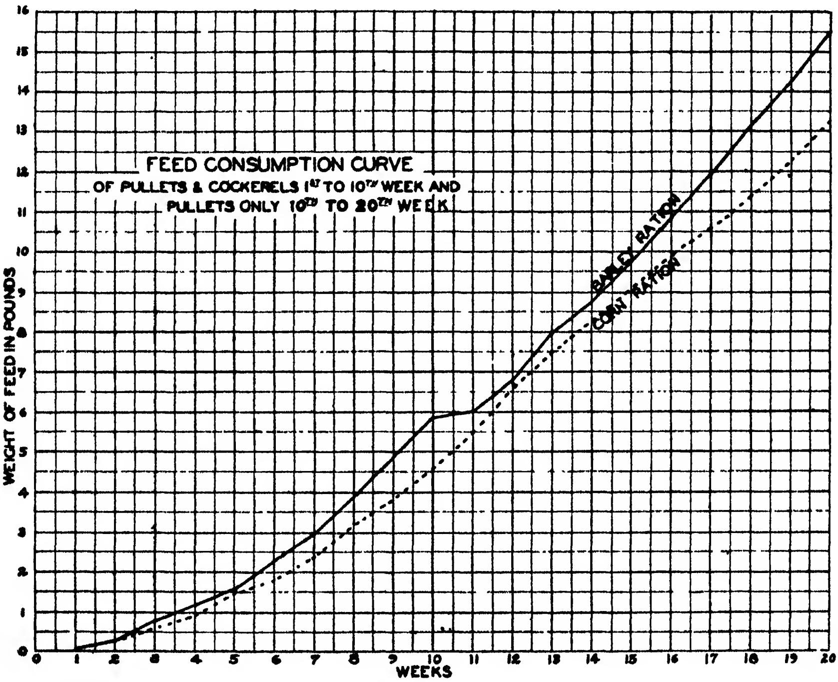

FIG. 2

matured in a satisfactory manner. Cockerels in both pens were taken out at 10 weeks of age and sold. When the pullets were 14 weeks old, they were vaccinated with fowlpox vaccine and an examination of figures 3 and 4 shows the effects on the weight of the pullets the following week. However, they overcame this setback the second week after vaccination and normal gains were made from then on.

Table 1 gives the weight of the birds in grams. At the tenth week when they were sold, the cockerels in the barley fed pen were 86 grams heavier than those in pen 2. This is approximately 1/5 of a pound. At 20 weeks of age, the pullets from pen 1 were 192 grams heavier than the pullets in pen 2, or approximately 2/5 of one pound heavier. The difference in growth is shown clearly in Figure 3 and Figure 5.

Table 1.—Weight of birds.

Week Number	Barley Ration—Pen 1		Corn Ration—Pen 2	
	Average weight of cockerels in grams	Average weight of pullets in grams	Average weight of cockerels in grams	Average weight of pullets in grams
1	56 75	54 1	58 57	55 8
2	94.81	88.7	91 4	85.8
3	129 45	121 4	123 9	114 6
4	185 8	174.5	173 7	157.8
5	253 76	238 6	224 85	202 4
6	316 28	290 4	280 55	251.6
7	393	358 8	357.76	313 9
8	444 19	392 6	424 63	363 2
9	550 34	479.7	485 2	415 7
10	661	564.5	575 48	475 2
11	..	669 0	....	502
12		749 7	.....	658 2
13		795.5	...	704 4
14		854.0	..	746
15		846.5	......	758
16		971 7	...	809 7
17		1019 4	....	860 1
18		1117 2	..	910 0
19		1155.5	.	972 7
20		1223 5	..	1031 5

In looking at Table 2, it may be seen that the birds which were fed barley consumed more feed than those which were fed corn. This is to be expected, as the former made heavier gains than did the latter. When the feed cost is estimated on the per pound gain basis, the barley ration produced a pound of gain just as economically as did the corn ration. There is only a slight difference in the price of the barley and the corn feed. This difference in price is slightly in favor of the barley, which is generally true of the two grains. It is interesting to note that the pullets in pen 1 ate more scratch grain per bird than did the pen of pullets in pen 2. Many poultrymen believe that corn is more palatable to poultry than is barley and, as the scratch grain used in each of these two pens was 50 per cent wheat and 50 per cent of either barley or corn, in this case, the birds ate more barley than corn. It was noticeable when the scratch grain was put in the hoppers that at first the birds in the barley pen picked out the wheat but later seemed to clean up the barley quite readily.

No alfalfa leaf meal was placed in the growing mash of either pen. This was omitted as the birds had access to a new grass range. The runs for each pen were moved frequently so that the pullets had green feed as long as the weather permitted. During the past summer, the drouth was so prolonged that all the range dried up and there was no green feed for the pullets at all. No succulent green feed was supplied when the pasture dried up and the birds were fed exactly the same as they had been earlier in the season.

When the pullets reached the age of 20 weeks, they were put in the laying house, the barley pullets being kept on the barley ration and the corn pullets on the corn ration. At this age, the barley pullets had no pigment in their shanks and beaks as they had been fed a ration which was free from zanthophyll. This material being present in corn

Table 2.—Weekly feed consumption.

Week Number	Barley Ration—Pen 1				Corn Ration—Pen 2			
	Scratch Grain		Mash		Scratch Grain		Mash	
	No. lbs. consumed per bird	Cost per bird in cents	No. lbs. consumed per bird	Cost per bird in cents	No lbs. consumed per bird	Cost per bird in cents	No lbs. consumed per bird	Cost per bird in cents
1....		...	.122	$0 40	...	...	12	$0 39
2.....		...	.198	0 64	...	.	21	0 68
3. ...	.	...	.484	1 57	...	...	.269	0 80
4..	.		.425	1 38	...		358	1 16
5. ..	.082	$0 16	342	1 11	087	$0 19	405	1 32
6 .	213	0 43	.432	1 40	124	0 27	30	0 68
7.	155	0 31	.582	1 72	144	0 31	407	1 22
8.	31	0 62	524	1 55	.161	0 35	584	1 75
9 .	443	0 89	.563	1 67	259	0 56	436	1 30
10	435	0 87	61	1 81	383	0 83	352	1 05
11	.46	0 92	.61	1 81	384	0 84	.527	1 58
12.	.60	1 20	227	0 67	421	0 92	628	1 88
13.	567	1 13	60	1 78	.516	1 12	44	1 32
14	51	1 02	271	0 80	453	0 99	337	1 01
15	357	0 71	60	1 78	3	0 65	.52	1 56
16	69	1 38	486	1 44	.5	1 00	.256	0 77
17.	422	0 84	644	1 91	.287	0 63	462	1 38
18	.577	1 15	.657	1 95	.316	0 69	.428	1 28
19.	373	0 75	65	1 92	405	0 88	515	1 54
20	715	1 11	.556	1 65	.403	0 87	.605	1 81
Total	6 909	.	9 583	.	5 143	. ..	8 159	... ...

	Barley Ration—Pen 1	Corn Ration—Pen 2
Feed consumed per bird during 20 week period	16 492 Pounds	13 302 Pounds
Feed cost per bird during 20 week period	42.47 Cents	35 67 Cents
Feed cost per pound gain	15 67 Cents	15 64 Cents

Price of feed per cwt.

Pen 1			Pen 2		
Starting Mash	Growing Mash	Scratch Grain	Starting Mash	Growing Mash	Scratch Grain
$3.25	$2 96	$2.00	$2 30	$2 99	$2 18

and alfalfa leaf meal, the corn fed pullets carried much more pigment than did the barley fed pullets.

In conclusion, there are two pens of pullets, one pen which is the heavier in weight and which is carrying no pigment in the shanks or beaks of the birds. The other pen, while not so heavy in weight, are carrying more pigment than their sister pen. These birds in both pens are to be carried over for one year and records will be kept of their egg production and of the hatchability of their eggs. Will the barley fed pullets come through and win out over the corn pullets. The answer

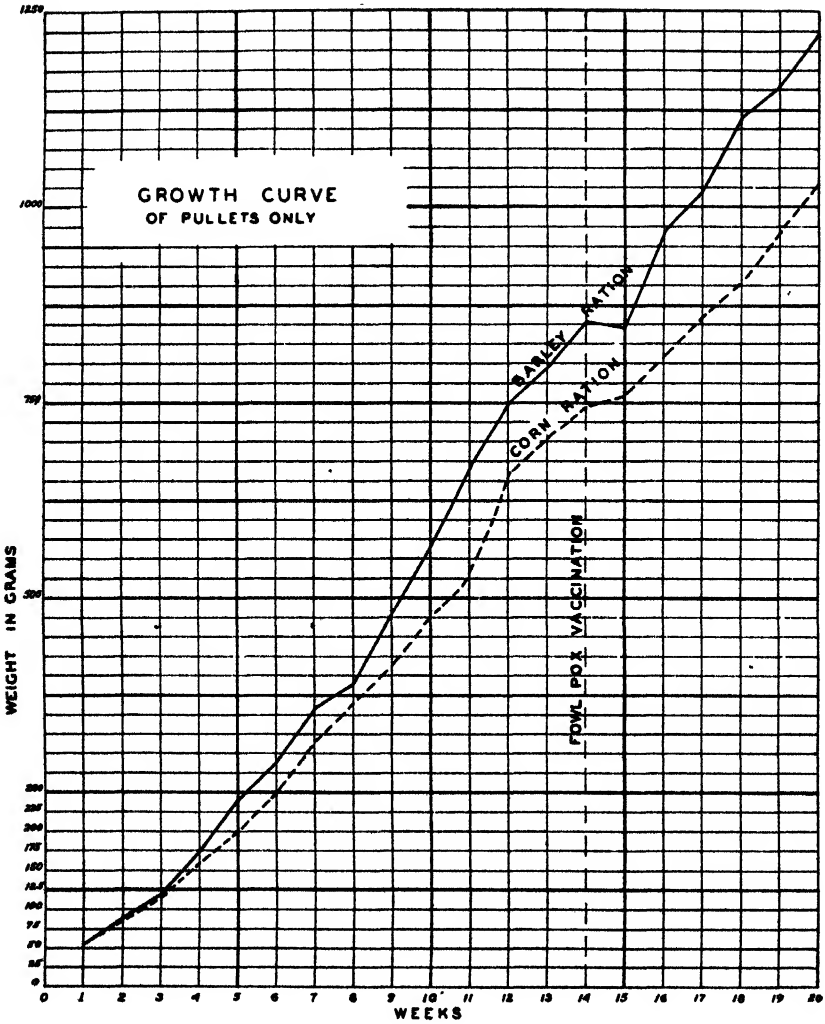
GROWTH CURVE
OF PULLETS ONLY
BARLEY RATION
CORN RATION
FOWL POX VACCINATION
WEIGHT IN GRAMS
1000
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
WEEKS

FIG 3

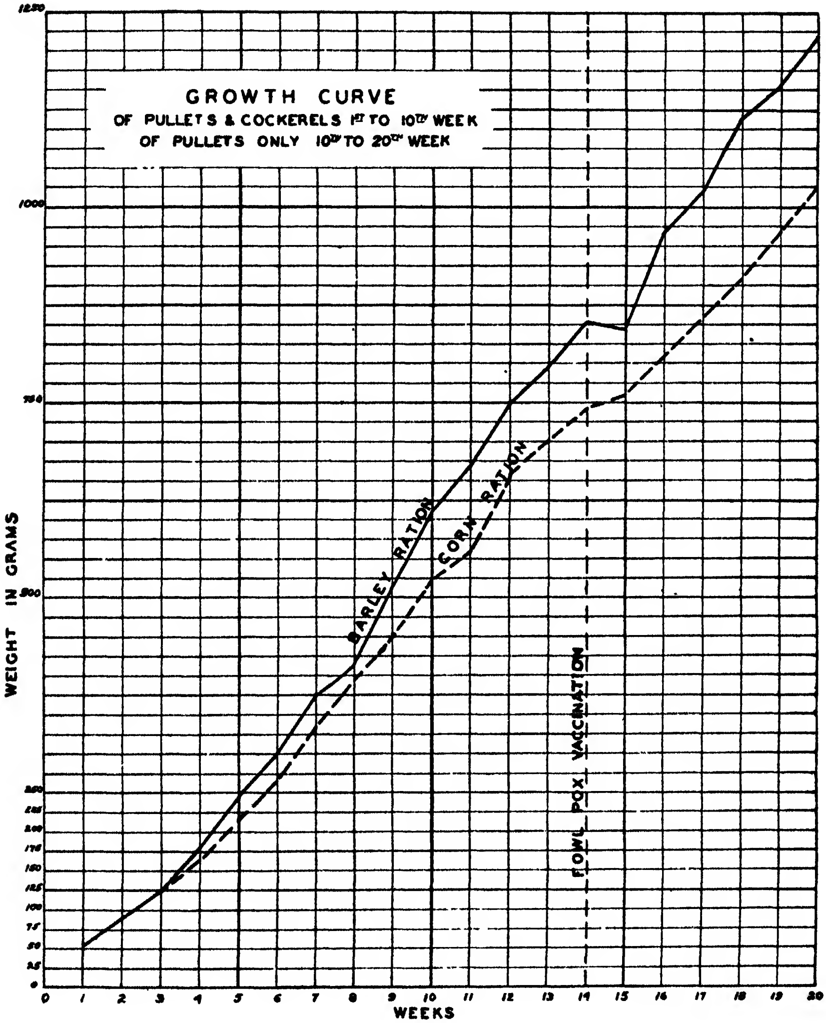
GROWTH CURVE
OF PULLETS & COCKERELS 1ST TO 10TH WEEK
OF PULLETS ONLY 10TH TO 20TH WEEK
BARLEY RATION
CORN RATION
FOWL POX VACCINATION
WEIGHT IN GRAMS
WEEKS
1250
1000
750
500
250
225
200
175
150
125
100
75
50
25
0
0
1
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FIG 4

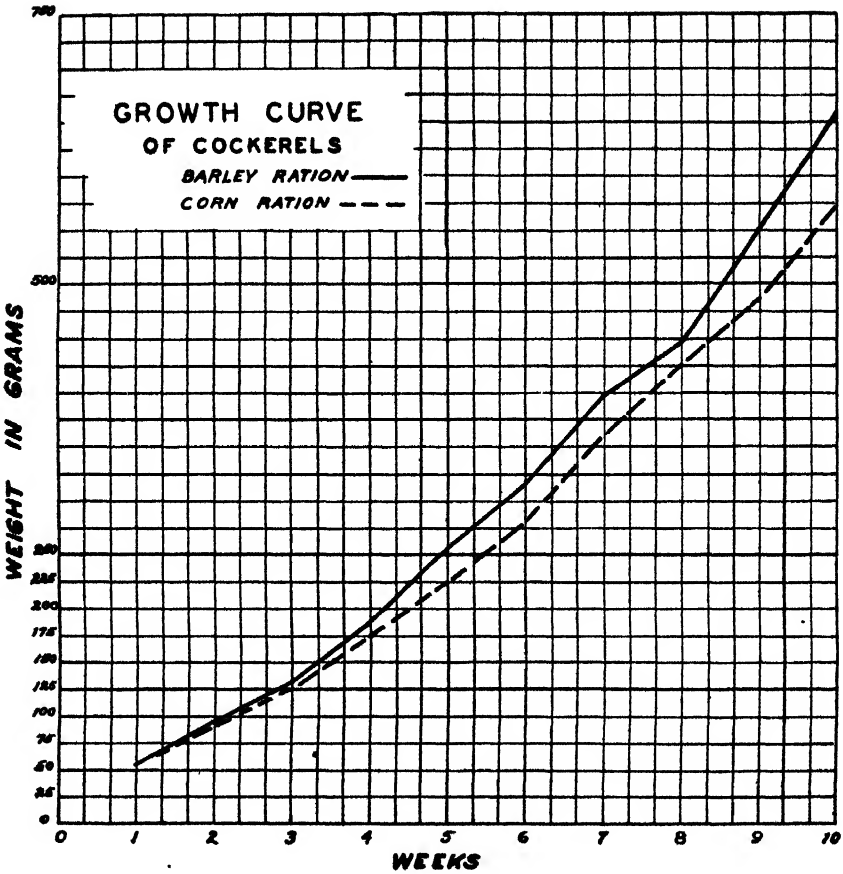


FIG. 5

to this question will determine whether barley is as good a poultry feed as corn. If the barley fed pullets during their growing period have received in the ration all the necessary elements for proper maturity, they should produce more eggs than the lighter weight corn fed pullets. The fact that the corn fed pullets are carrying more pigment in their skin may be an indication that they are healthier, sturdier, stronger birds. Although they weigh less than the barley fed pullets, they may prove to be more productive than their sister pen when they are matured. The real test of one growing ration against the other will be the ability of the birds receiving it to produce more eggs than the ones which were fed the other ration.

ORIENTAL PEAR STOCKS TESTED IN MICHIGAN

Experiments Indicate Their Use Will Not Give Good Results Here

BY STANLEY JOHNSTON, HORTICULTURAL SECTION

For many years seedlings of the common European pear (*Pyrus communis*) were used almost exclusively as stocks for the cultivated varieties of pears in both Europe and America. Though in general they made good orchard trees, their susceptibility to blight led to a constant search for forms resistant to that disease. In due course of time, it was discovered that several oriental species (notably *Pyrus ussuriensis* and *Pyrus calleryana* and likewise some forms of the Japanese pear, *P. serotina*) were markedly blight resistant and extensive trials were made with their seedlings. During the past two decades, nurserymen have budded large numbers of trees on these stocks and at present some firms are using them almost exclusively. This is but natural since early reports in the horticultural press and at various horticultural society meetings have led to the inference that such trees are especially valuable.

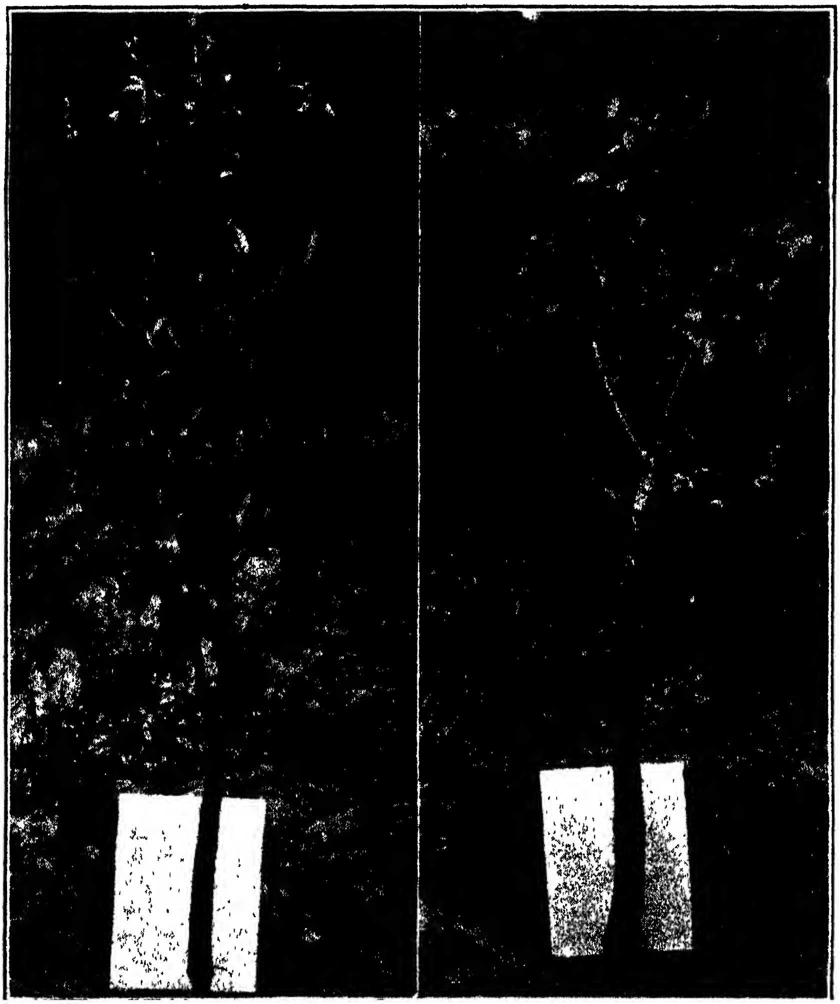
Observations at the South Haven Station, together with some of the more recent reports from the Pacific Coast States and from South Africa lead to the belief that much of this confidence in the value of these oriental stocks has been misplaced. Pear trees grown on seedling roots of *Pyrus calleryana* have shown great variation in growth. Some have made a very satisfactory, others a very poor, growth. There is also some evidence, in this State and from other sources, that seedlings of *P. calleryana* are subject to winter injury. A high percentage of trees grown at South Haven on roots of *P. calleryana* have had to be replanted.

Somewhat the same conditions have been found in trees budded on seedlings of *Pyrus ussuriensis*. There are two types of *P. ussuriensis* seedlings, those from seed gathered in the wild areas of China and those from seed of named varieties of *Ussuriensis*. Investigations in Oregon have shown that seedlings from the wild type are practically worthless as stocks. It is practically impossible to distinguish seed from the two sources, a fact that has sometimes been used to advantage by seed collectors in China. In view of these conditions the use of seedlings of *P. ussuriensis* is hazardous.

Trees grown on Japanese pear seedlings, *Pyrus serotina*, have made good unions and a satisfactory growth. However, in California where the Japanese pear seedlings have been used for a greater length of time, the fruit from trees grown on these seedlings is often rendered worthless by black-end, a physiological break-down causing the calyx end of the fruit to turn black. Japanese pear seedlings are also subject to mushroom root rot, a disease that may attack the root systems of trees grown on land recently cleared of forest trees.

Though French pear seedlings are more susceptible to blight than some

other stocks and also have a tendency to sucker, they are so satisfactory in other respects that they should be considered the best seedlings to use as rootstocks for pears in Michigan and probably in other districts of like climatic conditions. Eventually types or strains of one or more of the



Left: Old Home on Calleryana roots; top-worked to Bartlett.
Right: Flemish Beauty on French pear roots; top-worked to Bosc.

oriental species may be found that do not possess the faults of those now in use and that may be superior to French pear seedlings. In the meantime, however, nurserymen are to be discouraged from using Oriental pear seedlings and growers are to be cautioned against purchasing trees propagated on them.

EUROPEAN PINE SHOOT MOTH FOUND IN MICHIGAN

New Insect Pest Attacking Nursery Stock and Ornamental Plantings Makes Appearance

BY E. I. McDANIEL, SECTION OF ENTOMOLOGY

During the summer of 1930, the European pine shoot moth, *Phyacionia* (*Evetria*) *buoliana,* was collected on Scotch pine in the vicinity of Ann Arbor and Detroit. This is the first known record of the pest for the state. While the writer's experience with this moth thus far has been brief, the following facts are presented in the hope that they may give Michigan's Nurserymen and landscape gardeners information which will assist them in recognizing and controlling the pest.

The European pine shoot moth was introduced into this country from Europe on nursery stock, first having been reported on an estate on Long Island in 1914. The United States Department of Agriculture, immediately after the discovery of its introduction, made a survey of the region where the European nursery stock had been planted, and succeeded in locating infested areas in nine different states.[1]

Experience has shown that the European pine shoot moth is a serious pest of nursery stock and of young trees in ornamental plantings. Mature trees may be attacked but, other than serving as breeding places, such infestations are of but little importance. The malformation of young trees caused by the destruction of the terminal buds, the wholesale destruction of lateral buds and new shoots, and the injury to the young growth makes this insect an important pest. In variably, the terminal bud is destroyed first. During late summer, several buds may be destroyed by a single larva before it hollows out the particular bud which is to serve as its shelter during the winter. In the spring, the injury becomes more pronounced.

The larvae become active about the time that the sap begins to flow. They desert their winter quarters and attack one bud after another until the new growth develops. This new, soft growth furnishes an ideal food supply. The shoots are more or less completely tunneled and are mutilated in such a way as to finally cause their destruction. During this period, the larvae often migrate from one shoot to another until the ripening of the wood finally prevents them from easily gaining entrance. At this period, they often chew at the base of a shoot and thus mutilate it but fail to enter. It is this habit of feeding, on one side of a ripening shoot only, that causes serious deformities. An example of the effect of such mutilation is shown in Fig. 2. Such

[1]Busck, August—The European Pine-Shoot Moth: "A Serious Menace to Pine Timber in America." United States Department of Agriculture, Bulletin No. 170, 1915.

injuries are sometimes partially corrected as the years go on, but when mutilation occurs season after season, the trees finally become so distorted that their value is seriously impaired.

There is but one annual generation, the winter being passed in the immature larval stage. The larva becomes active very early in the spring and pupation takes place about the middle of May. The pupal stage lasts for about three weeks, being passed in a hollowed out shoot on the tree. When the moth emerges, the old pupal case is left protruding from the tunnelled shoot. The adults are nocturnal, hiding away on the trees during the day. Each female is capable of laying a large number of eggs which she places singly on buds. The adult moth has a wing expanse of three-fourths of an inch. The rusty orange-red fore-wings are marked with irregular, silver cross lines.

Fig. 1.—Larva of European Pine-Shoot Moth in new growth of red pine. From Dr. W. E. Britton, Entomologist, Connecticut Agricultural Experiment Station; slightly enlarged.

The mature larva is dark-brown in color with head, thoracic-plate, and anal shield black. It measures about two-thirds of an inch in length. The larvae of the European pine shoot moth are larger than any of our native *Rhyacionia*. Most of our native species have two generations a year, instead of one, and they usually confine themselves to a single host plant. Furthermore, in place of working wholesale destruction to buds, each one of the native species is satisfied with a single shoot. The European pine shoot moth has been reported from Illinois, Ohio, West Virginia, Pennsylvania, New Jersey, New York, Massachusetts, Connecticut, Rhode Island, and Florida in the United States, and from Ontario, Nova Scotia, and British Columbia in Canada. It confines its attack to pines, but all species of pine are infested. Other conifers have not thus far suffered.

Investigations which are now being conducted in Canada show that, in some districts, a number of native parasites have adapted them-

selves to the European pine shoot moth larva and in such areas the infestation is decidedly dropping.[2]

The most effective control measure that we have at the present time, is to cut and burn infested twigs late in the fall or before the middle of May. Some measure of control may be attained by keeping the new growth covered with arsenate of lead from the time it appears

Fig. 2.—Deformity to terminal growth of red pine caused by European Pine-Shoot Moth larvae. From Dr. W. E. Britton, Entomologist, Connecticut Agricultural Experiment Station.

to the last of May, since it is known that the larvae do some external feeding.

The entomology department of Michigan State College will be glad to examine specimens and to give advice on any suspected cases of infestation.

[2]Sheppard, R. W.—The European Pine-Shoot Moth in the Niagara Peninsula. 60th Annual Report Entomological Society, Ontario, 1929, page 73.

YIELDS OF COMMERCIAL WHEAT VARIETIES TESTED

Field Trials Used to Determine Comparative Values Under Variety of Conditions

BY H. C. RATHER AND C. P. WILSIE, FARM CROPS SECTION

During the season of 1929, the farm crops section of the Michigan Experiment Station started extensive tests of the leading commercial wheat varieties of Michigan, Ohio, and Indiana to determine the reaction of these varieties in yield and quality to different conditions of environment. Similar work was started with several of the same varieties by the experiment stations of Ohio and Indiana. The following tables give the yields secured in the Michigan trials in 1930.

"Test "A"—Ingham County

Location—Michigan State College, East Lansing

Soil—Hillsdale Sandy Loam

Variety	Yield, bus. per acre
Early Windsor	46.9
American Banner	44.8
Nabob	43.9
Selection 912203	41.7
Fulhio	40.8
Michigan Amber	39.9
Selection 28511	39.6
Red Rock	38.5
Berkeley Rock	38.0
Trumbull	37.1

Test "B"—Ingham County

Cooperator—F. E. Fogle, Mason

Soil—Miami Loam

Variety	Yield, bus. per acre
Fultz	38.6
American Banner	36.0
Red Rock	35.8
Selection 912203	35.4
Berkeley Rock	34.4
Trumbull	33.8
Fulhio	33.4
Selection 28511	31.4

Test "C"—Branch County

Cooperator—Glyn Havens, Union City

Soil—Fox Sandy Loan

Variety	Yield, bus. per acre
Selection 28511	26.1
Nabob	25.5
American Banner	24.9
Red Rock	24.1
Fultz	23.5
Fulhio	22.8
Berkeley Rock	22.3
Michigan Amber	22.2
Selection 912203	20.7
Trumbull	19.0

Test "D"—Branch County

Cooperator—Frank Foster, Quincy

Soil—Hillsdale Sandy Loam

Variety	Yield, bus. per acre
Selection 28511	34.3
American Banner	34.1
Berkeley Rock	33.4
Selection 912203	32.4
Fulhio	32.0
Trumbull	31.6
Michigan Amber	31.0
Nabob	29.7
Red Rock	29.4
Fultz	27.5

Test "E"—Kalamazoo County

Location—W. K. Kellogg Farm, Augusta

Soil—Fox Sandy Loam

Variety	Yield, bus. per acre
Selection 912203	32.2
Michigan Amber	30.5
Berkeley Rock	30.3
American Banner	29.8
Fulhio	29.3
Fultz	28.5
Nabob	27.7
Selection 28511	26.8
Trumbull	26.8
Red Rock	26.3

Test "F"—Cass County

Cooperator—H. D. Gleason, Cassopolis

Soil—Fox Sandy Loam

Variety	Yield, bus. per acre
Red Rock	23.1
Selection 28511	20.6
Local Variety	19.8
Trumbull	16.5
American Banner	16.0
Berkeley Rock	15.7

Test "G"—Tuscola County

Cooperator—W. R. Kirk, Fairgrove

Soil—Brookston Clay Loam

Variety	Yield, bus. per acre
O. A. C. No. 104 (Kirk)	46.8
O. A. C. No. 104 (Heckroth)	46.7
Trumbull	41.9
American Banner	36.1
Selection 912203	35.9
Selection 28511	31.9
Red Rock	31.5
Berkeley Rock	27.8

Test "H"—Missaukee County

Location—Michigan State College Potato Farm, Lake City.

Soil—Nestor Clay Loam

Variety	Yield, bus. per acre
Michigan Amber	36.8
Trumbull	35.9
Selection 912203	35.2
Red Rock	33.1
Nabob	32.8
Fultz	32.0
American Banner	31.9
Fulhio	31.8
Berkeley Rock	31.4
Selection 28511	24.7

Classification of Wheats in Over-State Tests

Variety	Kind	Source of Variety
*Selection 28511	Beardless soft red winter	Michigan
*Selection 912203	Beardless soft red winter	Michigan
Trumbull	Beardless soft red winter	Ohio
Fulhio	Beardless soft red winter	Ohio
Fultz	Beardless soft red winter	Indiana
Michigan Amber	Beardless soft red winter	Indiana
Nabob	Bearded soft red winter	Ohio
Red Rock	Bearded soft red winter	Michigan
Berkeley Rock	Bearded soft red winter	Michigan
American Banner	Beardless soft white winter	Michigan
*Early Windsor	Beardless soft white winter	Michigan
O A. C. No. 104	Beardless soft white winter	Ontario

*These strains not available commercially.

Discussion

Since the varieties included in these tests have all been carefully bred and selected very wide differences in yield are not to be expected. Neither can definite conclusions be drawn from this one year of experimentation. However, it is apparent that the older varieties such as Red Rock, Berkeley Rock, and Trumbull will find keen competition from the newer selections like Nabob, 28511, and others.

Unquestionably, the yields have been influenced by soil type and locality. The new beardless red wheat, selection 28511, did particularly well in southern Michigan but for some reason was very poor in Missaukee County. Although it was exceeded by several varieties in the East Lansing trials in 1930, Selection number 28511 is at the top on the basis of 6 year averages. Even at East Lansing, it was significantly out-yielded only by two white wheat strains, American Banner and Early Windsor.

American Banner proved itself to be widely adapted but was significantly outyielded on the heavy soils in Tuscola and Missaukee counties and on light soil in Cass. On most light soils, American Banner is at or near the top, and its defeat by Red Rock and 28511 in Cass County may be due to other than soil conditions.

The fields in Tuscola and Missaukee Counties were both well drained and red wheat varieties did best. The O. A. C. No. 104 is classed as a white wheat but possesses the characteristics of red wheat from a milling standpoint and will usually be graded commercially as a mixed wheat. Because Michigan millers have pointed out rather serious objections to O. A. C. No. 104 from a milling standpoint, this variety is not being recommended in this state.

While Early Windsor, a soft white wheat, is promising and outyielded American Banner in 1930, it has not done so over a period of years and there seems to be no reason to displace American Banner as the recommended variety of white wheat for Michigan. However, there is every reason to believe that Selection number 28511 or number 912203 will be equal or superior to any of the other red wheats and the Michigan State College contemplates introduction of one of these strains in the fall of 1931.

The tests as reported in this article are planned to cover a five year period and the accumulative results of this work should much more definitely establish wheat varietal adaptation in Michigan.

BACTERIA MAY CAUSE BAD FLAVOR IN BUTTER*

Protection of Cream From Contamination Aids in Production of Quality Butter

BY E D DEVEREUX, SECTION OF BACTERIOLOGY

During the past decade, there have appeared from this Station reports on researches on "Keeping Qualities of Butter," (1). This problem has been discontinued as a major project primarily because of lack of proper facilities for pursuing the studies. The last contributions to the project before its discontinuance were made by G. L. A. Ruehle.† A review of this work will be attempted at this time.

Experiments on the Production of Metallic Flavor in Butter and Milk

The development of off-flavors in dairy products is very intricate and interesting as well as of great economic importance. The price and salability of dairy products depends largely on flavor. Avoiding at this time a discussion of those flavors disagreeable in themselves, there are other flavors not particularly disagreeable nor even noticeable to the average consumer which are believed by the butter buyer to indicate poor keeping quality. Metallic flavor belongs to this latter class, and its presence may reduce the price of the butter several cents per pound.

By metallic flavor is generally understood a resemblance in flavor to that which is characteristic of metallic salts such as are formed by iron, copper, or zinc in acid solutions.

*This completes the series of articles on "The Bacteriological Background of Buttermaking."

(1) Sayre, Rahn, and Farrand. Part I, General Studies. Technical Bulletin 1, 1908.
Rahn, Brown, and Smith. Part II, The Influence of Salt; and Part III, The Decomposition of Proteins. Technical Bulletin 2, 1909.
Brown and Peiser. Port IV, Cream Ripening and its Influence. Technical Bulletin 29, 1916.
Brown and Peiser. Part V, Pasturization and its Influence. Technical Bulletin 30, 1916.
Brown, Smith, and Ruehle. A Bacteriological and Biochemical Study of Experimental Butters. Journal of Dairy Science, Vol. III, pp. 375-405, 1920.

†The complete report may be obtained by applying to this section for Mich. Agr. Exp. Sta. Technical Bulletin No. 102, Jan., 1930. Keeping Qualities of Butter. G. L. A. Ruehle.

This flavor defect is not always sharply defined and is often being accompanied by other more or less pronounced off-flavors.

Frequently it borders on oiliness, it may approach fishiness, and occasionally it appears to be a nuance of tallowy flavor.

During the course of the investigation, various salts, amino acids, and microorganisms were added to milk and butter to determine their ability to produce metallic flavors. The results indicated rather definitely that a metallic flavor may be imparted to milk and butter by the presence of iron or copper lactate and by the presence of amino acids, which are decomposition products of proteins. The metallic flavor due to the addition of metal salts is likely to be followed by a tallowy flavor or other undesirable flavors, but the metallic flavor due to the products formed by bacterial action on proteins is likely to persist for an indefinite period and it grows worse in many cases. The presence of iron or copper lactate, metallic salts, is the more serious cause of trouble since the flavors succeeding the metallic flavor are much more disagreeable than the metallic flavor itself.

From the foregoing statements, the value of well-tinned utensils should be quite evident.

The Microbic Flora of Off-flavored Butters

In addition to off-flavors that are due to purely chemical processes in butter, there are those that are undoubtedly due to microorganisms. This phase of the investigation was to determine the part played by microorganisms in the production of off-flavors.

Voluminous data were collected on about 300 organisms isolated from off-flavored butters. Cultural characteristics of these organisms were obtained, and the ability of these organisms to produce off-flavors in milk was determined. Determinations were made on the effect of growing the organisms alone in milk and in association with a butter starter organism, *Streptococcus lactis.*

The work proved that microorganisms can produce off-flavors in butter. This disposes of the idea that the only cause of off-flavors in butter is when the cream is already off-flavored before the butter is made. Also, off-flavors such as metallic, kerosene, woody, weedy, and other similer flavors need not necessarily be produced by the substances suggested but are often produced by microorganisms. Some of the organisms produced other interesting flavors as pecan flavor, nutty flavor, fruity, machine oil, and vomitus. It was also noted that, in the presence of the butter starter organism, *Streptococcus lactis,* the off-flavors were frequently intensified, occasionally lessened, or even changed entirely.

The results of these experiments indicate that it is essential to reduce the contamination of cream by undesirable organisms to a minimum if desirable butter is to be consistently produced.

POULTRY HOUSE HEATER HELPS EGG PRODUCTION

O. E. ROBEY, AGRICULTURAL ENGINEERING SECTION

Losses in egg production due to sudden drops in temperature during the winter months have long been a source of annoyance to poultrymen. These losses can be prevented to a large extent by the use of artificial heat in the poultry house during these cold spells. It is not necessary to maintain a high temperature at these times.

The average brooder stove can be easily converted into a poultry house heater. By building a jacket around the stove, a more uniform temperature throughout the house can be maintained. This is essential as a high temperature in the neighborhood of the stove is undesirable since it has a tendency to cause the hens to huddle near the stove and not use the entire floor space for exercising.

Figures 1 and 2 show a comparatively simple way of building a jacket. The stand should be made strong enough to hold up the stove and to prevent the possibility of overturning. By having the stove raised off the floor, the floor will not become heated and the full floor space will be available: It is essential to construct the heater so that there will be the least possible danger from fire. Fire hazard can be eliminated to a large extent by providing a sheet iron bottom to the heater that will prevent cinders or ashes from dropping in the litter when being removed. At A and B, Figure 1, the details of the construction of the stand and the bottom are given. The edges of the bottom are turned up to prevent cinders from rolling off in the litter. The legs of the stand are high enough so that a galvanized iron basket can be set partly under the heater when removing the ashes. It will be noted that the sheet iron bottom extends to the edge of the outer jacket at the ash door.

The jacket itself is made of galvanized sheet iron formed in the shape of a pipe or cylinder. The top and bottom are reinforced with band iron. A door also made of sheet iron, which may be reinforced around the edges with band iron, is placed on the front for convenience in filling the stove with coal and in removing the ashes.

The air enters at the bottom in the annular space between the sheet iron bottom and the outer jacket, it becomes heated and passes out of this jacket at the top which should be left open. A cylinder of wire netting may be used at the top to prevent the birds from jumping upon the heater. One quarter-inch mesh hardware cloth may also be used around the bottom. A baffle of sheet iron placed above the jacket will assist in diverting the heated air toward the walls of the coop.

On most brooder stoves, the arm supporting the thermostat can be changed so that the thermostat can be placed on the outside of the jacket. The heat of the coop can then be controlled automatically.

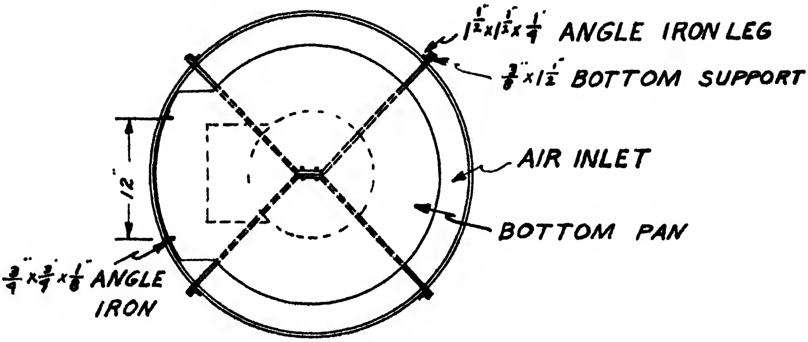


FIG. B

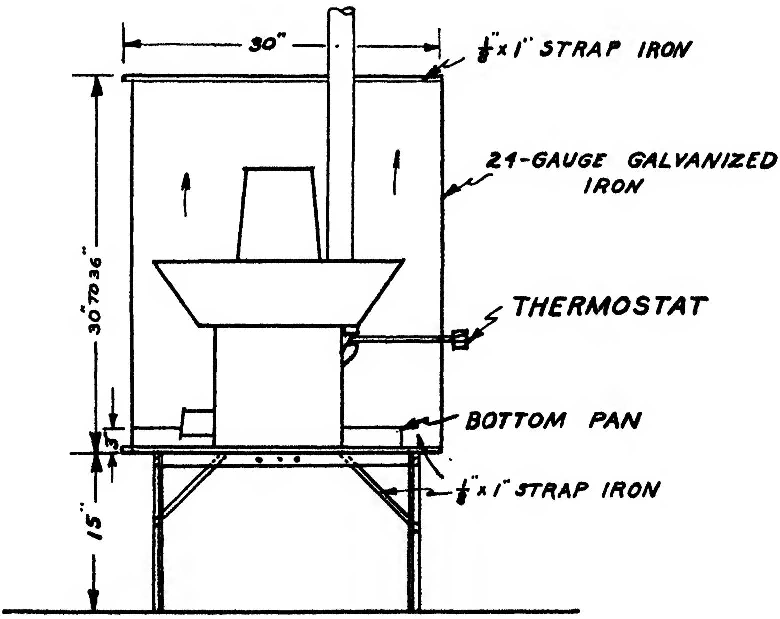
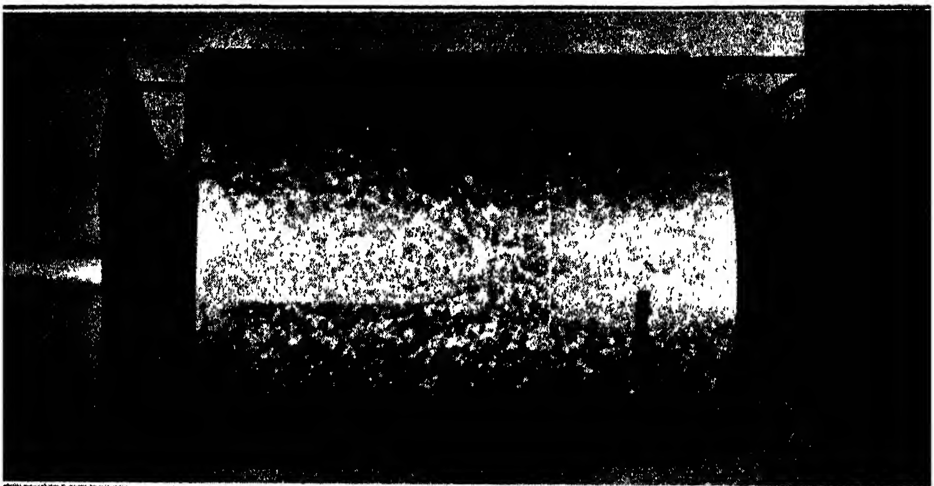
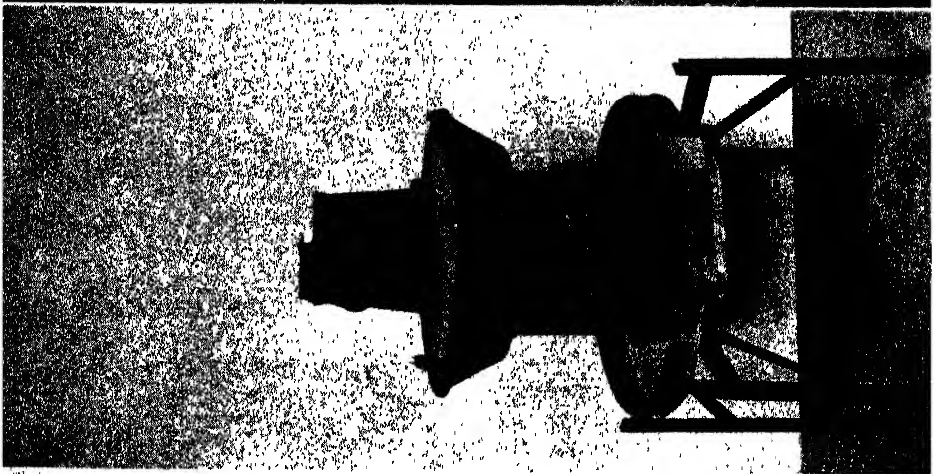
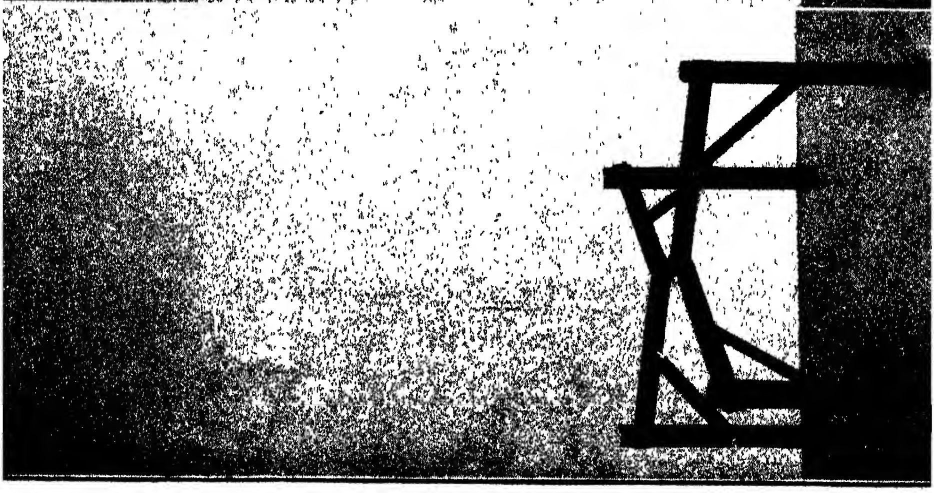


FIG. A

Fig. 1.—Cross section of heater showing construction.







EIGHTH MICHIGAN EGG LAYING CONTEST CLOSES

Hens Make Good Showing Despite Short and Unfavorable Season

BY E. S. WEISNER, POULTRY SECTION

The Eighth Michigan Egg Laying Contest which closed September 23, provides a wealth of information of interest to all poultrymen. One thousand three hundred birds of seven breeds and varieties were entered in the competition. Each entry consisted of 13 birds, the record of the 10 high individuals being taken to figure pen totals. Acting under the direction of the American Record of Performance Council the contest was cut short five weeks to permit the ninth contest to begin October 1, 1930. With the early beginning, it is believed that the number of birds having colds and those that have been in heavy production preceding their entry in the contest will be greatly reduced. The latter group are highly susceptible to changes and are too easily thrown into a complete molt.

One significant point brought out by the contest is shown clearly in Table No. 1, which gives the average contest production per hen for the various breeds and varieties. In spite of the shorter period of competition, a very severe winter, and the hottest and driest summer on record at East Lansing, these figures compare favorably with the average production of the past seven contests.

A departure from past practice was the adoption of a standard point system under which every egg produced was weighed separately and given a value in points. Table No. 2, shows the value in points based on weight in ounces per dozen. Table No. 3, fifth column, shows the average points per egg for the different breeds and varieties. When interpreted in terms of ounces per dozen, these data show that the average egg produced in the contest closely approaches the two ounce egg class and is in the highest commercial egg grade. These figures collected from the weighing of every egg produced by the 1300 hens indicates that the system, including the increased labor, is justified and that when the grading of commercial eggs becomes established the poultrymen of Michigan will be in a position to realize on their labor of breeding for size in eggs as well as numbers.

Another interesting point of the past contest, as shown in Table No. 3, is the comparison of grain and mash consumption with egg production. This table shows the amounts of each feed consumed, the number of eggs produced, and the average points per egg of the various breeds and varieties.

Table 1.—Average contest production compared to past years

Breeds	1929-30	1922-29
Barred Rocks	157 11	166.8
White Rocks	125 80	166 8
White Wyandottes	139 10	147 2
S. C. Reds	163 10	165.4
R. C. Reds	169 30	165 4
Leghorns	193 03	194 4
All Breeds	180 48	184 1

1929-30 Contest was of 10 mo. 3 wks. duration.

Table 2.—Egg weights and value in points.

Ounces per dozen	Value in points
26 and up	1 10
25	1 05
24	1 00
23 and down decreasing	05 points per oz
18.	70

Table 3.—Amounts grain and mash consumed during year. Average eggs produced and points per egg of various breeds and varieties.

No. of Birds	Breed	Grain	Mash	Eggs	Average Points
260	Barred Rock	8,616	11,310	157 11	.93
39	White Rock	1,254	1,721	125 80	92
26	White Wyandotte	870	1,268	139 10	94
78	S. C. Red	2,717	3,722	163.10	.94
26	R. C. Red	936	1,139	169 30	95
871	Leghorn	26,380	34,468	193.03	98
1,300	All Breeds	40,773	53,628	180 48	97

MICHIGAN HAS RECORD SMALL GRAIN CROPS

Methods of Producing 1930 Yields Show Value of Good Farm Practices

BY P. R. MILLER, FARM CROPS SECTION

Bumper crop yields invariably bring forth questions as to the variety of seed used, the time of planting, the amount and kind of fertilizer, the amount of seed per acre and the rotation followed. To answer such questions and to encourage the adoption of those practices which make for more profitable yields and higher quality, the Ira H. Butterfield Memorial Grain Growing Contest was arranged for Michigan farmers in 1927 at the suggestion of the late Ira H. Butterfield, one of Michigan's early agricultural leaders.

Mr. Butterfield's suggestions led to the establishment of one of the most interesting and instructive projects of the Michigan State Fair. Shortly after Mr. Butterfield's death, the Michigan State Fair Board made the grain growing contest a permanent memorial to him, renaming it the Ira H. Butterfield Memorial Grain Growing Contest. Interest in the contest has grown steadily since the beginning in 1927, and the contest is now regarded as the annual round-up of Michigan's best small grain performances. One hundred and forty-eight Michigan farmers entered fields in the 1930 contest.

Fields eligible for entry must be five acres or more in size. Yield per acre and the commercial value of the threshed grain constitute the bases of awards. The yields are attested to by disinterested witnesses, while the commercial value of the grain is determined by a committee of judges at the State Fair, this determination being based on the commercial grade of the grain and the Detroit market price of grain of that grade at the time of the Fair.

A summary of the cultural practices used by the 1930 winners for three crops follows.

Wheat

Nine of the 15 winning contestants in wheat grew improved varieties bred and developed by Michigan State College plant breeders. American Banner was planted by six and Red Rock by three of the contestants. American Banner was released from Michigan State College in 1906 and has proved a very dependable, bald, white winter wheat suited to the lighter loams and less well drained heavy soils. Red Rock was released in 1913 and is a bearded, soft, red winter type of excellent milling quality suited to well drained fertile loams and heavy soils. The 15 winning yields ranged from 51.0 to 59.3 bushels per acre. Fourteen of the 15 winners used commercial fertilizer at an

average rate of 200 pounds per acre. Planting dates for all of the fields ranged from September 10 to September 27 with the rate of seeding between one and three-fourths and two bushels per acre. All of the fifteen winning contestants followed rotations that included either sweet clover or alfalfa during the three previous years.

Ernest Kniverim, Blissfield, winner of first place, secured a yield of 59.3 bushels per acre on a field that was an alfalfa sod for the three previous years and was top dressed with 12 loads of lamb manure in the spring. In addition, one-half of the field had 12 loads of steer manure before it was plowed. The crop was planted early and received 145 pounds of 0-14-6 fertilizer per acre.

The similarity of improved practices employed among all contestants is readily apparent even when geographical location is taken into consideration. The first place winner is located in Lenawee County, and the second place winner, John Kaye, Custer, is located over 200 miles further north in Mason County. The cultural practices employed by both, even to time of planting, are strikingly similar.

Oats

In the oat class much the same situation is revealed. Twelve of the 15 winning contestants grew improved varieties released from Michigan State College. The Wolverine and Worthy varieties were evenly divided among the 12 contestants. The Wolverine variety was released from Michigan State College in 1917 and is a very productive variety for lighter loams and upland soils. The Worthy oat was released in 1911 and is a stiff strawed variety adapted to heavy soils. Winning yields ranged from 92.4 to 125.5 bushels per acre. Twelve of the 15 contestants used commercial fertilizer at an average rate of 150 pounds per acre. Planting dates ranged from April 5th to April 25th. The rate of seeding was between one and one-half and three bushels per acre. Seven of the 15 winners followed definite rotations which included legumes sometime during the three previous years.

George Aldrich & Sons, Fairgrove, winner of first place, grew a yield of 125.5 bushels per acre on a field which was in beans in 1929, alfalfa in 1928, and barley seeded to alfalfa in 1927. The field was planted April 10 at the rate of two bushels per acre and received 100 pounds of 20 per cent super-phosphate per acre.

Barley

In the barley class, Spartan and Wisconsin Pedigree were the varieties used by the 15 winning contestants. Spartan, the new stiff strawed, smooth-awn variety, released in 1928 by the Michigan State College, was grown by 13, and Wisconsin Pedigree by two of the 15 winners. Winning yields ranged from 60.2 to 66.9 bushels per acre. Fourteen of the 15 winners used commercial fertilizer at an average rate of 125 pounds per acre. Planting dates ranged from April 8 to April 28 and the average rate of seeding was between one and one-half to two bushels per acre.

Ferdinand Foss, New Haven, winner of first place, secured a yield of 66.9 bushels per acre on a field of Spartan barley that was in beets in 1929, corn in 1928, and clover in 1927. The crop was planted April

20 at the rate of two bushels per acre and received 200 pounds of 2-12-2 fertilizer.

Summary of cultural practices followed by winning contestants. Wheat-Oats-Barley—1928-1929-1930.

Variety -Year	Per cent fields planted to improved varieties	Time of seeding range	Yield in bu. per acre range	Rate of seeding range bushels	Average rate commercial fertilizer per acre, pounds	Per cent contestants using legumes during three previous years
Wheat:						
1928	80	Sept. 13-Oct. 1	19.2- 52.4	1½-2	225	80
1929	80	Sept. 5-Oct. 1	32.0- 46.9	1½-2	225	65
1930	60	Sept. 10-Sept. 27	51.0- 59.3	1¾-2	200	100
Oats:						
1928	80	April 20-May 7	50.2- 92.0	1¼-2½	185	80
1929	80	April 16-May 7	52.5- 91.0	1¼-2¼	150	70
1930	80	April 5-April 23	92.4-125.5	1½-3	150	50
Barley:						
1928	100	April 19-May 1	32.6- 62.5	1¼-2	200	75
1929	87	April 16-May 10	32.7- 65.5	1¼-2	150	80
1930	100	April 8-April 28	60.2- 66.9	1½-2	125	30

Summary

1. Eighty per cent of the winning exhibitors in the 1930 contest planted improved varieties of wheat, oats, and barley developed by Michigan State College Plant Breeders.
2. Sixty per cent of the winning exhibitors in wheat, oats and barley grew legumes in the rotation during the three previous years. Alfalfa was the most common legume used.
3. Eighty-five per cent of the winning exhibitors in wheat, oats, and barley used commercial fertilizer at an average rate of 200 pounds for wheat, 150 pounds for oats, and 125 pounds for barley.
4. Early planting at a normal rate of seeding on well prepared seed beds was a practice followed by all of the winning contestants.
5. Improved practices followed by all contestants were strikingly similar regardless of geographical location and soil differences.
6. Favorable conditions of climate in 1930 combined with proper cultural practices resulted in yields surpassing those of previous contests.

FRUIT TREE BARK BEETLE DAMAGES ORCHARDS

Peach and Cherry Growers Send Unusual Number of Complaints of Injuries

BY R. H. PETTIT, SECTION OF ENTOMOLOGY

All through the summer and early fall, complaints, often accompanied by specimens of insects, have been coming to the entomology department. Cherry growers complained that they were finding mutilations of twigs covered and sealed in by dried droplets of gum. The same injuries have occurred in peach orchards, although perhaps fewer complaints have come from the peach growers than from the cherry growers. The removal of one of these dried droplets will usually reveal a small cavity eaten into the twig, a cavity which contains no insect and which appears as a cleanly cut tunnel through the bark, penetrating for a short distance into the wood. Similar injuries have been noticed on apple and other tree fruits, the wounds in such cases not being covered with a gummy exudate. These punctures in the twigs and in the smaller branches of fruit trees are almost invariably made by the fruit-tree bark-beetle and are made by the insect for the purpose of feeding rather than for breeding purposes.

These little beetles, about one-twentieth of an inch long, breed freely between the bark and the wood of practically all of our fruit trees, as well as in wild cherry. They attack trees in low vigor and seldom molest healthy specimens. They breed under the bark in the trunks and larger limbs of trees that are dying or which are in low vigor. The sickly condition of the tree may be caused by too much or too little moisture, by hard-pan, by crown gall, by root aphids, or by mechanical injury. Attacks of this nature are becoming more and more common, and complaints are coming in more often as time goes on.

The whole situation is discussed in extension bulletin No. 74, which will be sent to any one on request. Growers who have noticed drops of gum or lesions of which the cause is unknown are urged to send specimens to the Department of Entomology, for examination.

Freshly cut brush from wild cherry or large prunings from any of the fruit trees are very likely to harbor this pest and to supply places for them to breed from which they fly and attack the living healthy trees. Though the insect does its greatest injury to the twigs of *healthy vigorous* trees, it breeds and multiplies in the trunks and larger limbs of any of the fruit trees which may be in low vitality and is especially fond of wild cherry.

TEST EFFECT OF DELAYED HARVEST OF WHEAT

Use of Combines Brings Up Questions of Moisture Content and Test Weights

BY C. P. WILSIE, FARM CROPS SECTION

The increased use of the combine-harvester on Michigan farms has brought up the question of the effect of delayed harvest upon the quality of wheat, as harvested under Michigan conditions. In 1929, one field of American Banner was observed in which the wheat had a test weight of only 54 pounds per bushel. The kernels were plump and dry, and milling tests showed the wheat to be of good quality in all other respects. It was harvested with a combine about two weeks after binder harvest, and several rains occurred during those two weeks. Workers at other experiment stations have suggested that rains coming after the wheat is mature cause the berries to swell and that they do not resume their original size upon drying. This would satisfactorily explain the light weight of this wheat. Wheat of light test weight falls into lower market classifications and is considered less desirable for milling purposes because of its lower yield of flour.

An investigation was started in 1930 to obtain more information on this problem of delayed harvest, which is necessary when combines are used under Michigan conditions. Often, the wheat must stand from a week to 10 days after the binder harvest date before it can be combined and stored safely. A half-acre field of American Banner wheat on the college farm was divided into 80 plats each one rod square. Five dates of harvest were used, the first one being just before binder cutting stage and the last one about 10 days after the wheat was ripe enough to combine and store safely or about 17 days after the time for binder harvest. The moisture content of the grain was determined, by the Brown-Duvel method, at the time of harvest in all excepting the first two cuttings. For these early cuttings, the moisture was very high and the grain difficult to thresh out. Sixteen plats were harvested on each date, shocked in the field, and when thoroughly dry were threshed and the yields and test weights were determined. The moisture content at threshing was low for all lots, being around 10 per cent.

The weather* during this harvest period was unusually hot and dry. There was only one-half inch of rainfall during the month of July and the mean maximum temperature during the harvest period was 86° F. The data obtained are shown in Table I.

The test weight did not decrease to any extent even at the last cutting date. This would indicate that in a dry harvest season the quality of combined wheat, as expressed by general appearance and test weight, would not be impaired by late harvest.

*Weather data secured from United States Weather Bureau, East Lansing.

Table I.—Moisture, yield, and test weight of wheat.

Harvest date	Per cent moisture	Yield per acre	Weight per bu.	Stage of development
July 5	High	46 5	59 3	Soft dough
July 8	High	48 1	60 5	Medium dough
July 11	30 8	42 7	60 5	Hard dough
July 18	12 0	44 5	60 5	Dead ripe
July 25	10 6	38 0	60 0	Over ripe, shattering

The lowest yield was obtained at the last harvest date, at which time there was a considerable loss from shattering due to the fact that the wheat was over ripe and unusually dry.

Moisture In Combined Wheat

Determinations of the moisture content, of wheat near Webberville, Michigan, which was to be harvested with a combine, were made. Samples were cut by hand in the field and threshed with a small plat thresher on several days before the combine was started, and, after the combine was started, samples were taken directly from the machine.

Table II.—Moisture content of wheat.

Date	Per cent moisture	Condition of Grain
July 14, 2 P. M.	32	Binder harvest stage
July 16, 2 P. M	22 7	Combine started July 18
July 19, 2 P. M.	11 0	Combined—dead ripe
July 28, 2 P. M	10 8	Combined—slight shattering
July 29, 2 P M	10 8	Combined—slight shattering

When the combine was started on July 18, the test weight per bushel was 58.5 pounds. On July 29, eleven days later, the test weight was 58.75 pounds which again indicates that during a dry season the delaying of harvest necessary in order to combine wheat at a moisture content sufficiently low for safe storing does not mean a lower test weight.

To obtain some data on the length of the combine-day during harvest season, moisture determinations were made on samples collected at various hours during the day. A steady decrease in moisture was noted from morning to late afternoon as shown by Table III.

It will be noted that the wheat had a relatively low moisture content and, even over night, did not exceed a moisture content safe for storing, namely 14 per cent. During a dry harvest season such as 1930, with the weather conditions which prevailed, a combine could be operated long days, probably from 8 a. m. to 7 p. m. or longer. It is very likely, however, that during a damp season or even during a normal season very different data would be obtained. Investigations must be carried on under different kinds of harvest seasons here in Michigan, before anything definite can be said regarding the length of day a combine can be operated; the weather conditions are the main factors which affect its use.

Table III.—Moisture content at various hours during day.

Time	Per cent moisture	Weather
July 28, 7:30 A. M.*	13 4	Clear, some dew
July 28, 8:00 A. M	13 8	Maximum temperature 96°
July 28, 9:00 A. M	13 6	Relative humidity, 7 A M. 76%
July 28, 10:00 A. M	12 7	Relative humidity, 12 M. 39%
July 28, 11:00 A. M	12 8	Relative humidity, 7 P M. 44%
July 28, 12:00 M	11 7	
July 28, 2:00 P. M	10 8	
July 28, 4:00 P. M	10 6	
July 28, 5:45 P. M	10 0	
July 28, 6:30 P. M	10 2	
July 29, 7:00 A M.*	11 2	Clear, little dew
July 29, 8:00 A. M.*	11 2	Maximum temperature 80°
July 29, 9:00 A M	11 5	Relative humidity, 7 A. M. 74%
July 29, 10:00 A. M	11 2	Relative humidity, 12 M. 38%
July 29, 12:00 M	11 4	Relative humidity, 7 P. M. 45%
July 29, 2:00 P. M	10 8	
July 29, 4.00 P. M	10 4	

*Harvested by hand before combine was started in morning

ABORTION-INFECTED HERD OF CATTLE STUDIED

Percentage of Abortion and Sterility Highest in Animals Having Positive Reaction to Blood Test

BY C F. CLARK, SECTION OF ANIMAL PATHOLOGY

The data summarized here were obtained from a pure-bred dairy herd, numbering 60 to 100 animals of breeding age. Since March, 1926, monthly agglutination tests for *Br. abortus* infection have been run on this herd. Breeding records have been carefully kept for each animal.

This summary is made from the breeding records of 100 animals which have been tested monthly for from two to four years each. The reason for selecting these 100 animals is to include only those animals tested a minimum

Summary of breeding records.

	No. of animals	No. of pregnancies	No. of pregnancies terminating in abortion	Per cent of pregnancies terminating in abortion	No. of animals became sterile	Per cent of animals became sterile	No. of Br. abortus infected udders*	Per cent of Br. abortus infected udders
Negative	39	123	17	13%	3	7%	1**	2%
Suspicious	26	107	10	9%	8	28%	3	11%
Positive	35	127	38	30%	20	57%	22	62%

*Data relative to udder infection were kindly furnished by Mr. J. P. Torrey of the Bacteriology Section.
**Br. abortus was isolated from the udder of this animal on one occasion only.

of two years. No effort has been made to select or to omit any particular animals in order to influence results. Animals have been classified as negative, suspicious, or positive according to their final agglutination reaction. In this summary, the word abortion means a fetus delivered dead or non viable, even though the length of gestation in some cases was approximately normal.

In considering the surprisingly high abortion rate in the negative group reported, the following facts should be borne in mind.

1. This group of negative animals includes several old cows. Some of the parturitions listed occurred before systematic testing was begun in March, 1926. Some of these animals may have had a suspicious or positive reaction at some time in their early history.
2. Several of the animals in this group were known to have had heavy streptococci infections of udder and fetal membranes.
3. In certain cases the cause of abortion was determined. (B. coli, Vibrio fetus, Streptococci.)
4. Some of the animals in this group gave suspicious, and some positive reactions at some time in their history of testing.

Summary of blood reactions.

Number of animals	Reacted positively in dilution of 1/50					
	Became negative	Per cent became negative	Remained suspicious	Per cent remained suspicious	Became positive in higher dilution	Per cent became positive in higher dilution
18	7	38%	6	33%	5	28%
Number of animals	**Reacted positively in dilution of 1/100**					
	Became negative	Per cent became negative	Became suspicious	Per cent became suspicious	Remained positive	Per cent remained positive
54	6*	11%	12	22%	36	67%

*Five of these six animals were positive less than four months.

Positive animals occasionally gave suspicious or negative reactions but such a condition was usually temporary. Of the 39 positive animals in the summary, 14 gave negative reactions at some time after becoming positive. Nine, 65 per cent, of these animals were negative four months or less, before becoming positive again. These results illustrate the necessity of frequently testing animals varying in reaction in order to determine their true status.

The statement that a positive animal occasionally fails to react about the time of delivery is often made. On the nine animals mentioned in the preceding paragraph, only two exhibited the negative phase near the time of parturition.

Summary

1. Positive animals had two and one-half times as many abortions as negative animals.
2. Sterility was four times as frequent in suspicious animals, and eight times as frequent in positive animals as in negative animals.
3. A majority of positive animals, 62 per cent, and an appreciable number of suspicious animals, 11 per cent, had *Br. abortus* infected udders.
4. Of animals positive in 1/50, 38 per cent became negative, 33 per cent became suspicious, and 28 per cent became positive in a higher dilution.
5. Of animals positive in 1/100, 11 per cent became negative, 22 per cent became suspicious, and 67 per cent remained positive.
6. Out of 100 animals studied, only one was positive in 1/100 more than three months and subsequently became negative.
7. No animals studied reacting positively in 1/50 or 1/100 more than 10 months became and remained negative.

The Bulletins of this Station are sent free to such individuals as may request them. Address all applications to the Director, Agricultural Experiment Station, East Lansing, Michigan.

LIST OF AVAILABLE BULLETINS

Regular Bulletins—

262 Suggestions on Planting Orchards.
264 Second Report of Grade Dairy Herd.
267 Michigan Weeds (only to Michigan libraries and teachers. Others 25c).
277 Studies in the Cost of Market Milk Production.
281 Beautifying Farm Home Grounds.
284 Some Information and Suggestions Concerning the Use of Phosphorus.
286 Studies and Cost of Milk Production—No. 2.

Special Bulletins—

71 Studies in the Range and Variation of the Per Cent of Butter Fat in the Milk of Individual Cows.
83 Key to Orthoptera of Michigan.
90 Special Report of the Upper Peninsula Experiment Station.
91 Lime for Michigan Soils.
94 The Financial History of a Twelve-Year-Old Peach Orchard.
98 Vinegar.
100 Soy Beans.
101 Oats in Michigan.
106 Sugar Beet Growing in Michigan.
107 Diseases of Bees in Michigan.
110 Special Report of the Upper Peninsula Experiment Station.
111 Studies in City Milk Distribution.
120 The Microscopic Identification and Determination of the Specific Ingredients in Stock Feeds.
123 Second Growth Hardwood Forests.
124 The Colorimetric Hydrogen-ion Determination as a Means of Locating Faulty Methods at City Milk Plants.
125 Michigan Potato Diseases.
126 An Analysis of the Peach Variety Question in Michigan.
127 Nitrogen-Carrying Fertilizer and the Bearing Habits of Mature Apple Trees.
128 Sandy Soils of Southern Peninsula of Michigan.

130 The Clovers and Clover Seed Production in Michigan.
133 Fertilizers. What they are and how to use them.
134 Greenhouse Insects.
135 Seasonal Management for Commercial Apiaries.
136 The Muck Soils of Michigan.
138 Rural Highways.
139 Tourist Camps.
141 Profitable Pruning of the Concord Grape.
142 Grafting in the Apple Orchard.
143 Winter Pruning the Black Raspberry.
144 Spraying Dewberries for Anthracnose.
146 Air-cooled Storage for Apples.
147 Cherry Leaf Spot.
149 Eighty Winters in Michigan Orchards.
150 Emergency Hay and Pasture Crops.
151 Buckwheat in Michigan.
152 Sweet Clover.
153 Peppermint Growing in Michigan.
154 Hardy Shrubs.
155 The Mint Flea Beetle.
156 Investigation With Strains of Beans.
157 Celery Culture in Michigan.
158 A Suggested Bacteriological Standard for Ice Cream.
159 Production of Ice Cream With a Low Bacterial Count.
160 Why a Cull Apple Is a Cull.
161 Varieties, Locations, and Men in Apple Production.
162 Pruning the Red Raspberry.
163 Forest Planting in Michigan.
†164 Diagnosing Orchard Ills.
165 Management Methods in the Raspberry Plantation.
166 Studies in Orchard Management with Special Reference to Cherry Production.
167 Chicory Growing in Michigan.
169 Profit and Loss in Pruning Mature Apple Trees.
170 The Detroit Milk Market.
171 Farmers' Co-operative Buying and Selling Organizations in Michigan.
172 Farm Real Estate Assessment Practices in Michigan.
173 The Principal Bulb Pests in Michigan.

†This is a popular bulletin on the identification of the more common disorders of tree fruits in Michigan. It should be found generally useful as a work of reference for practically everyone interested in the raising of fruit.

Because of the unusual expense of the color plates it will not be distributed to the entire mailing list but will be sent to those who specifically request it, upon the receipt of ten cents (coin or stamps).

Circular Bulletins—

***Bulletins listed in bold faced type are recent publications of this Station.**

60 Lime Requirement for Kalamazoo County.
61 Paying for Milk on a Quality Basis as a Means of Improving the Supply.
62 The Simplex Lime Spreader.
64 Simple Water Systems.
66 Tests with Sugar Beets.
67 The Cherry Maggots.
68 The Cherry Leaf Beetle.
69 Orchard Cover Crops.
70 The Present Status of the European Corn-Borer in Michigan.
71 Fertilizer Suggestions for Barry County Soils.
72 Fertilizer Suggestions for Berrien County Soils.
73 Fertilizer Suggestions for Cass County Soils.
74 Fertilizer Suggestions for Hillsdale County Soils.
75 Fertilizer Suggestions for Ingham County Soils.
76 Fertilizer Suggestions for Isabella County Soils.
77 Fertilizer Suggestions for Kalamazoo County Soils.
78 Fertilizer Suggestions for Livingston County Soils.
79 Fertilizer Suggestions for Macomb County Soils.
80 Fertilizer Suggestions for Muskegon County Soils.
81 Fertilizer Suggestions for Ottawa County Soils.
82 Fertilizer Suggestions for St. Joseph County Soils.
83 Fertilizer Suggestions for Van Buren County Soils.
85 Honey Vinegar.
87 Apple Maggot.
88 Fertilizer Suggestions for Calhoun County.
90 Cucumber Culture.
91 Arbor Day Programs for Rural Schools.
93 "Sting" on Apples.
94 Fleas and Bed-Bugs.
95 Feeding Minerals to Dairy Cattle.
96 Seed Corn Curing and Storing.
97 Cottage Cheese.
98 How to Make and Preserve Cider.
100 Michigan Farmers Tax Guide.
101 Cockroaches, Silver-fish, and Book-lice.
102 Farm Lease Systems in Michigan.
103 Prevention of Wind Injury to Crops on Muck Land.
104 Clothes-Moths and Carpet Beetles.
105 Sweet Corn.
106 Flies Commonly Found in Dwellings.
107 Mexican Bean Beetle.
108 Organic Matter in Berrien County Soils.
109 Organic Matter in Ingham County Soils.

110 Organic Matter in Kalamazoo County Soils.
111 Organic Matter in Ottawa County Soils.
112 Organic Matter in Van Buren County Soils.
113 Organic Matter in Calhoun County Soils.
114 Organic Matter in Livingston County Soils.
115 Organic Matter in Hillsdale County Soils.
116 Organic Matter in Macomb County Soils.
117 Distribution of Acid Soils, Muskegon County.
118 Distribution of Acid Soils, Jackson County.
119 Distribution of Acid Soils, Hillsdale County.
120 Distribution of Acid Soils, Ingham County.
121 Distribution of Acid Soils, Kent County.
122 Distribution of Acid Soils, Tuscola County.
123 Farm Milk Houses.
124 The Young Vineyard.
125 The Mint Flea Beetle.
126 Essentials of a Mulch Paper Laying Machine.
127 Pruning Young Fruit Trees.
128 Undulant Fever in Man and Abortion Disease in Cattle.
***129 Results of a Long Time Mineral Feeding Experiment with Dairy Cattle.**
***130 Cultural Methods in the Bearing Vineyard.**
***131 The Cherry Fruit-Flies.**
***132 June Beetles or White Grubs in Michigan.**
***133 Soft Scales Injurious to Deciduous Ornamentals.**
***134 Wood-boring Insects Which Attack Furniture and Buildings.**

Quarterly Bulletins—

Vol. I, No. 1, August, 1918	Vol. IV, No. 3, February, 1922
Vol. I, No. 2, November, 1918	Vol. IV, No. 4, May, 1922
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Vol. VIII, No. 2, November, 1925
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Extension Series Bulletins—

2 The Babcock Test.
13 Oat Smut and Its Control.
17 The Stinking Smut of Wheat
19 Grasshopper Control.
20 Hotbeds and Cold Frames.
22 Effective Crop Exhibits.
23 Alfalfa.
24 Utilizing Poles and Timber in Farm Buildings.
25 Feeding Cull and Surplus Potatoes.
26 Swine Feeding.
27 The Kitchen Sink.
31 Capons.
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34 Setting a Standard for Seed.
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44 Coming Through with Rye.
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49 Better Potatoes for Michigan.
50 Profitable Oat Production in the Upper Peninsula of Michigan.

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51 Feeding for Eggs.
52 Care and Feeding of Growing Chicks.
53 Chick Diseases in Michigan.
54 Diseases of Adult Poultry.
55 Plowing for European Corn Borer Control.
56 Renting or Keeping Bees for Use in the Orchard.
57 Lime for Michigan Soils.
58 Culling the Farm Flock.
59 Methods of Control for the European Corn Borer.
60 Insect and Disease Control in the Home Orchard and Vegetable Garden.
67 Producing Sugar Beets.
68 A 10′ x 12′ Portable Brooder House.
69 A Simple Electric Water System.
70 Soil Management for Profitable Corn Production.
71 Value and Care of Farm Manure.
72 Wiring the Farmstead.
73 Barley, Cull Beans, and Potatoes as Feeds for Dairy Cattle.
74 The Fruit Bark-Beetle.
75 The Oriental Peach Worm.
76 Some Common Sucking Insect Pests of Evergreens.
77 The Tar-Paper Packing Case for Wintering Bees.
78 The Fruit Tree Leaf Roller.
79 Apple-Maggot.
80 Grape Root-Worm.
81 Growing Lima Beans for the Canning Factory.
82 Growing String Beans for the Canning Factory.
83 Growing Peas for the Canning Factory.
84 Growing Sweet Corn for the Canning Factory.
85 Dairy Goats.
86 Sheep Raising in the Upper Peninsula.
87 Silo Filling With Five Horse Power Electric Motor.
***88 Grinding Grain with Electric Power.**
91 Wheat Varieties for Michigan.
92 Beauty in Furniture Arrangement.
93 The Background of the Room.
94 Better Bulls Increase Dairy Profits.
95 Why Cream Tests Vary.
96 Why Milk Tests Vary.
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***98 Essentials in Clean Milk Production.**
***99 Agricultural Outlook for Michigan—1930.**
***100 Arrangement of Barn Floor Plans—General Purpose Barn.**

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***101 Standard Dimensions Used in Laying Out Barn Plans.**
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***103 Portable Hog Cots.**
***104 Plan of Potato Storage Cellar.**
106 Accounting for Stored Produce.
107 Some Economic Aspects of the Bean Situation.
108 Selecting a Sire for the Dairy Herd.

Club Bulletins—

2 Potato Club Work.
3 Bean Club Work.
***5 Pig Club Work.**
7 Corn Club Work.
9a Clothing Club Work.
10 Canning Club Work.
11a Handicraft Club Work.
11b Handicraft Club Work.
12 Hot Lunch Club.
***15 Food Preparation.**
17 Dairy Club Work.
18 Poultry Club Project.
19 Forest Planter's Handbook.

Technical Bulletins—

21 How Contact Insecticides Kill.
32 The Transmission of Bacterium Abortus (Bang) to the New Born Calves Through the Ingestion of Milk.
33 A Study of the Presence of Bacterium Abortus (Bang) in Milk.
34 A Study of the Factors Which Govern Mating in the Honey Bee.
48 The Lecania of Michigan.
50 Rate and Extent of Solubility of Minerals and Rocks Under Different Treatments and Conditions.
59 Flat Sours.
60 The Influence of Manufacturing Operations on the Bacterial Content of Ice Cream.
61 The Relation of High Cellular Counts to Bacterium Abortus Infection of the Udder.
62 Some Physical and Chemical Properties of Several Soil Profiles.
64 The Salt Requirements of Marquis Wheat in Water Culture for the Vegetative Phase of Development.

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65 Studies on a Non-Virulent Living Culture of Bact. Abortus Towards Protective Vaccination of Cattle Against Bovine Infectious Abortus (Bang's Abortion Disease).

66 The Significance of Bacterium Abortus Antibodies (Agglutinins and Complement-fixing) Found in the Sera of Calves at Birth or After Nursing.

67 Investigations on the Blackleg Disease of Potato.

68 Bacterium Pullorum.

69 The Fruiting Habits and Pruning of the Concord Grape.

70 The Nutrient Requirements of the Strawberry.

71 Growth of Lettuce as Influenced by Reaction of Culture Medium.

72 Potato Spraying and Dusting Experiments in Michigan.

73. Adsorption by Activated Sugar Charcoal.

74. Effect of Nutrient Conditions on Colloidal Properties of Certain Vegetable Crops.

75 Influence of Nutrient Supply on Earliness of Maturity in Cabbage.

76 Concentration of Materials and Rates of Application in the Control of Apple Scab.

77 The Influence of the Reaction of Cultural Medium on the Growth of the Strawberry Plant.

78 The Effect of Certain Nutrient Conditions on Activity of Oxidase and Catalase.

79 Tests for Incipient Putrefaction of Meat.

80 Virus Diseases of Raspberries.

81 Storage and Transportational Diseases of Vegetables Due to Suboxidation.

82 Commercial Casein.

83 A Study of the Sanitary Significance of Air in Relation to Ice Cream.

84 The Clarifier and the Filter in Processing Milk.

85 Studies in the Etiology of Roup and Allied Diseases.

86 The Relation of Milk Solids Not Fat to Overrun and Quality of Ice Cream.

87 Paper Wrappers and Their Effect Upon Physical and Chemical Properties of Horticultural Products.

88 Investigations on Winter Wheats in Michigan.

89 Ultimate Effect of Hardening Tomato Plants.

90 The Breeding of Strains of A-Tester Yellow Dent Corn.

91 Taxes on Michigan Rented Farms.

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Technical bulletins, as the name implies, are devoted to reports of scientific research and designed more especially for use of other investigators, instructors and students.

The Quarterly bulletin contains contributions by all sections of the Experiment Station. It is issued during February, May, August, and November of each year. Copies are sent to the entire mailing list. The Quarterly also contains a list of available bulletins.

*Bulletins listed in bold faced type are recent publications of this Station.

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Single Copies of bulletins are for free distribution as long as the supply lasts. Quantities of bulletins may be secured at cost.

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SUB-STATIONS

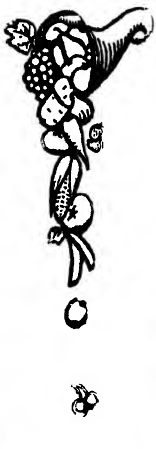
Chatham, Alger County, 780 acres deeded, G. W. Putnam, Director.
South Haven, Van Buren County, 10 acres rented; 5 acres deeded, S. Johnston, Superintendent
Graham Station, Kent County, 50 acres donated by R. D. Graham; 50 acres purchased, Walter Toenjes, Superintendent.
Dunbar, Chippewa County, Forestry Station, 577 acres deeded, Putnam Robbins, Superintendent.
Lake City Experimental Potato Farm, Missaukee County, 640 acres purchased or under contract. Ashley Berridge, Superintendent.
Kellogg Demonstration Farm and Wild Life Sanctuary, Kalamazoo County, 900 acres donated by W. K. Kellogg; C. M. McCrary, Superintendent.
Monroe, Monroe County, Corn Borer Station, 7½ acres rented.

THE QUARTERLY BULLETIN

AGRICULTURAL EXPERIMENT STATION

MICHIGAN STATE COLLEGE

Of Agriculture and Applied Science



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V. R. GARDNER AND A. J. PATCH

CONTRIBUTIONS BY ALL SECTIONS OF THE
AGRICULTURAL EXPERIMENT STATION

MICHIGAN AGRICULTURAL EXPERIMENT STATION QUARTERLY BULLETIN
Vol. XIII, No. 3, February, 1931

MARKET SURPLUS WHEAT AS PORK

Low Market Value of This Grain Enables Feeders to Use It at a Profit

V. A. FREEMAN, SECTION OF ANIMAL HUSBANDRY

Though wheat has been often used in the grain mixture fed to pigs, its market value has until recently been so high that first class wheat has not usually been fed as the main part of the pigs ration. A trial during the past summer and fall at this Station shows that pigs will do well on a ration of wheat, when properly supplemented, and that feeding it to hogs is a profitable method of marketing much of the surplus low-priced wheat now on Michigan farms.

Two lots of pigs were self-fed inside with access to a concrete exercise lot outdoors. Lot 1 had access to shelled corn and a supplemental mixture of tankage 70 per cent and linseed oil meal 30 per cent. Alfalfa hay was kept in a rack where they could help themselves. Lot 2 was fed the same combination except that coarsely-ground wheat was placed in their feeder instead of corn. Both were watered at automatic waterers. The results are shown in the accompanying table.

Though the wheat-fed lot required slightly more feed to produce the same gain, they gained equally as rapidly and attained about equally as good finish for market as did the corn-fed pigs.

The return per hundredweight of grain fed was 21 cents higher for the corn than for the wheat, but only 4 cents higher per bushel and much of the time during the feeding trial corn would have cost more than that much more than wheat.

These hogs were sold when the market was near the low point of the past year and netted 8 cents per pound in the feed lot. Had they been earlier pigs and ready for market a few weeks earlier, the returns would have been decidedly increased.

The pigs were fed free choice but chose practically the same proportion of supplemental feed in both lots.

Some supplemental protein-rich feed, such as tankage or skim milk, should always be fed with wheat and this supplement should be fed in a larger proportion to small pigs than to fattening hogs. These pigs in the feeding trials were started at average weights of only 36 pounds.

The cost of grinding the wheat was not estimated, as it varies greatly under different conditions, but this cost should be deducted from prospective returns because grinding is necessary for satisfactory results. The spread between the present market values for wheat and the returns from it when

fed to hogs is more than ample to cover grinding and other overhead costs, including labor, and indicates a profit from feeding surplus wheat to swine.

Table 1.—Comparative results of feeding wheat or corn to pigs.

July 16—December 2, 1930

Self Fed, Free Choice	Lot No. 1 Shelled Corn Tankage 70% } mixed Linseed Meal 30% } Alfalfa Hay	Lot No. 2 Ground Wheat Tankage 70% } mixed Linseed Meal 30% } Alfalfa Hay
Number pigs finished	8	8
Total pig days	1,112	1,112
Initial wt. of lot	288 lbs.	289 lbs.
Average initial wt. per hog	36	36 12
Final wt. of lot	1,500 6	1,511 3
Average final wt. per pig	187 58	188 81
Total gain of lot	1,212 66	1,222 33
Average gain per pig	151 58	152 79
Average daily gain per pig	1 09	1 10
Feed Consumed:		
Shelled corn	3,711	. .
Ground wheat	.	4,114
Tankage	487 7	493 4
Linseed meal	209	211
Alfalfa hay	140	167
Total	4,547 7	4,985 4
Feed per 100 Pounds Gain:		
Shelled corn	306	. . .
Ground wheat		336 57
Tankage	40 21	40 36
Linseed meal	17 23	17 26
Alfalfa hay	11 54	13.66
Total	374 98	407 85
Average Daily Ration:		
Shelled corn	3 34	
Ground wheat	.	3 70
Tankage	44	.44
Linseed meal	19	.19
Alfalfa hay	13	.15
Total	4 10	4 48
Returns from Grain:		
Value of gain at 8 cents per pound	$97.01	$97 79
Cost of supplements	23 69	24 21
Tankage at $3.50 per cwt.	17 07	17 27
Linseed meal at $2.50 per cwt	5 22	5 27
Alfalfa hay at $1.00 per cwt.	1 40	1 67
Grain return per lot	73 32	73 57
Return per cwt.:		
Corn	1 97	....
Wheat	. ...	1.78
Return per bushel:		
Corn	1 11	....
Wheat	... .	1.07

FOREST PLANTATION SUCCEEDS IN QUACK GRASS

P. W. ROBBINS, SECTION OF FORESTRY

The control of quack grass in cultivated crops has long been a problem for the farmers in some localities of Michigan. Reforesting abandoned farm lands which are in quack grass sod is now presenting a hard problem in some parts of Michigan. The experience of the Dunbar Forest Experiment Station in replanting quack grass invaded areas on run-out farm lands may be helpful to any one contemplating reforesting lands of this character.

The soil on the area planted at the Dunbar Station is characteristic of the podsol type sandy soils found in many parts of Michigan. It is a light sand with a coffee-brown subsoil 8 to 16 inches below the surface. This brown layer is very hard and impervious to water, often causing such lands to be poorly drained.

This land was furrow-plowed in the spring of 1927 with a walking plow to reduce somewhat the competition from the quack grass which the trees would otherwise encounter. The sod was so heavy it made plowing very difficult, and the plowing depth had to be increased from three inches to five and six inches in order to turn the sod and keep the plow in the ground.

Five thousand Norway spruce two-year-old seedlings were used in the planting. The seedlings were spaced six feet apart in the furrow and the furrows were eight feet apart. This gave approximately 900 trees to the acre. Weather conditions at the time of planting were favorable for the establishment of the trees. However, a dry period during the last of August and the first of September, followed by a wet spring in 1928, when some of the furrows filled with water and covered the seedlings, resulted in the loss of many of the trees. The seedlings had no root competition from the grass during the 1927 growing season; however, by the middle of the second growing season, the grass was well established in the furrows and the seedlings were well hidden by the grass.

In the fall of 1929, all the dead trees were replaced with three-year-old spruce seedlings. The number planted and the per cent of survival is as follows:

Number of seedlings planted in 1927	5,000
Number of seedlings replaced in 1929	1,777
Per cent of survival	64.46

The success of this plantation is favorable considering the adverse planting conditions.

The per cent of survival could probably be increased by using a tractor or a horse-drawn sulkey-plow to furrow-plow the area before planting. With such a plow, shallow furrows could be turned in the heavy quack grass sod, which would enable planting the seedlings two to three inches nearer to the top of the grass where they would receive more sunlight. Planting in a shallow furrow would also put the seedling in better soil and reduce the danger of the furrow becoming filled with water during the wet season to such a depth that it would cover and cause the death of the trees.

CONTROLLING THE PEACH TREE BORER

Use of Simple Chemical Treatment Kills Pests and Prevents Injury

RAY HUTSON, SECTION OF ENTOMOLOGY

The peach tree borer, *Sanninoidea exitiosa,* does more readily preventable damage to the peach than any other insect in Michigan. It is a native pest which transferred its attentions many years ago from wild cherry and wild plum to cultivated stone fruits. Today, the peach is so noticeably the preferred host that the fact is reflected in the accepted common name. The injury inflicted by the peach tree borer causes each year the death of thousands of peach trees and weakens other thousands which then die from drought, freezing, other insects, or disease.

Adult peach tree borers are day-flying, wasp-like moths, steely-blue in color, and about one and one-fourth inches in wing-spread. The male moth is the smaller and has three or four yellow stripes across the abdomen which are represented in the female by one broad orange band. Despite the handsome appearance of the adult borers, the larval form is more generally known to the grower. The larvae hatch from the 200-800 small reddish-brown eggs commonly laid at the crowns of the trees during July and August.

The "borers" (larvae) are thread-like at first, but immediately seek rough places in the bark and burrow. The presence of borers is at first indicated by brownish borings on the bark, but later, after tunneling into the deeper layers of bark, the gummy mixture of sawdust which one comes to associate with infestations of this insect begins to accumulate. The winter is passed in the burrow. The borers begin feeding early in the spring and continue until about the first of June. Examinations of infested trees at this time reveal several sizes of borers. Mature, dirty-white peach borers are about one inch long.

The work of the peach tree borer is marked by the accumulation of gum and frass about the crown of the tree. The gum comes from the injured tissues and the size of the mass often indicates rather closely the extent of the borings. The peach borer feeds largely upon the inner portions of the bark, although the shallow tunnels sometimes are partially in the sapwood. The cambium layer of the tree is killed at the point of attack, and since there are usually many borers to a tree, a large percentage of the water and food-carrying system is destroyed. A heavy infestation of borers may girdle a tree. A light or moderate infestation over a period of years will accomplish the same effect. No peach grower needs to be told how complete girdling will affect a peach tree. Before trees are completely girdled by successive light infestations, a dry year, disease, fruit tree bark beetle, or a hard winter may intervene to finish the weakened tree. Whatever the infestation, peach tree borers will reduce the profitably productive life of a peach tree.

Formerly the only way of eliminating peach tree borers was by digging the borers from the tree. This method, because of its obvious disadvantages in orchard application, stimulated investigation which resulted a few years ago in the present universally employed paradichlorobenzene treatment.

Paradichlorobenzene is so satisfactory for peach tree borer control that it ranks as a "specific." Its application is, of course, bounded by the limita-

Fig. 1.—Recommended method of applying paradichlorobenzene about peach tree.

tions of borer life history, weather, and soil condition. It happens that in Michigan these factors balance best during the month of September. At this time, the borer eggs have hatched or are hatching, the soil temperature is above 60° F., and the soil is workable. Paradichlorobenzene should be applied at this time for best results in borer control.

In calculating dosages for peach trees, the size of the trunk rather than the age should be considered. However, the rule is, one-half ounce to trees less than three years old, three-fourths ounce to trees between three

and six years old, and one to one and one-half ounce to older trees, as determined by the diameter. There are precautions which must be remembered in applying paradichlorobenzene. Peach trees are very susceptible to overdosages of this material; therefore, in using it, do not exceed recommended dosages, be sure to keep it from actual contact with the tree, and never apply it in summer.

Paradichlorobenzene is applied by forming a ring of the crushed crystals, at the proper dosage for the tree, one to three inches from it. This can be accomplished more easily if weeds, gum, and grass are removed, without loosening the soil or exposing the roots to the chemical. After formation of the ring of paradichlorobenzene, it should be covered with a few shovelfuls of earth. Paradichlorobenzene applied in this way volatilizes into a gas which kills the borers. On extremely heavy soils, it is best to draw the material away from the trees after about three weeks, but there are only a few places in Michigan where this need be done. When the mounded soil is removed, its replacement by fresh soil will forestall winter injury to tissues that may have remained tender because of having been covered during the season when, with normal exposure to the air, they gradually acquire greater hardiness to cold.

OYSTER SHELL SCALE CAUSES SERIOUS LOSSES

E. I. MC DANIEL, SECTION OF ENTOMOLOGY

For several years, the oyster-shell bark-louse *Lepidosathes ulmi* has steadily become more and more annoying and destructive. Especially is this true when we consider its attacks on certain shade trees and shrubs, notably lilac. Attempts to control this scale in various parts of the country for a time met with indifferent success, which induced various investigators to look more closely into the habits and development of this pest. Professor Glenn, chief inspector of orchards and nurseries in Illinois,[1] following up this lead, arrived at the conclusion that we have at least three different races of oyster-shell bark-louse in this part of the world. The presence of two races was suspected as long ago as 1880, by Professor J. H. Comstock.[2] This view has been borne out by results obtained by various other investigators, and is now generally accepted as a matter of fact. Of these three, one known as the "brown form" is common on apples and possesses a "shield" of a uniform brown color. This is probably the best known of the three forms. Further south this race is said to produce two generations a year. However, in the latitude of Michigan, there has been no evidence of a second generation. It is found on a large number of different host plants, though so far as our own observations go, it is largely confined to fruits, such as apple, pear, peach, plum, and quince. It is also sometimes found on hackberry, and horsechestnut, but this particular brown form

[1]Journal Economic Entomology, Vol. 13, No. 2, April, 1920, p. 173.
[2]Comstock, J. H., U. S. Dept. Agr., Bul. 372, 1880, p. 475.

has not thus far been found on lilac or poplar. Trees that receive regular dormant applications of lime-sulphur or oil emulsions, such as are recommended to control the San Jose scale or red mite, are seldom seriously troubled. The majority of growers usually consider the oyster-shell scale as a pest of minor importance, since it usually confines its operations to trees weakened from some other cause. In a neglected orchard, or in one where the dormant application is omitted, this brown race of oyster-shell bark-louse is often kept in check by parasites or other natural enemies.

Perhaps the least known of the recognized races is the one known as the "yellowish-brown form." In this form, the posterior half of the shield is much lighter in color than the front portion. This coloring is clearly noticeable on living scales. This yellowish-brown race has never been found on fruit trees. It is common on birch and poplar. In common with

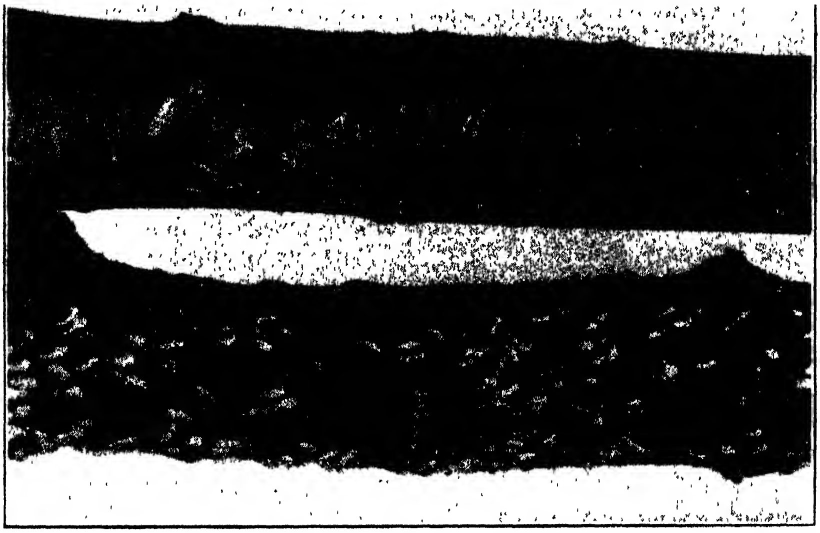


Fig. 1.—Oyster-shell bark-louse enlarged. Above "brown form," below "gray race."

the brown race, this particular yellowish-brown race has never become very troublesome. It has a number of natural enemies, which thrive at its expense. In the South, this race is said to be double-brooded.

A third race, which is known as the "grayish-brown," or banded form, stands by itself. It resembles the form common on apples, except that the shield itself is crossed by irrigular white bands, giving the scale a grayish appearance. This race does not infest apples or any of the fruit trees, but is common on walnut, butternut, maple, birch, beech, willow, poplar, ash, dogwood, and lilac, as well as some other deciduous trees. It differs from most of the other races mentioned, in that no parasites have ever been reared from it.

Aside from the differences just cited between the races in respect to their scaly coverings, there exist as well certain anatomical differences in the insects themselves—differences that definitely separate each race from its

neighbors under microscopic examination. All three races agree in that they pass the winter in the egg stage under the scaly covering, and in this region all three produce but one annual generation. The gray race of the oyster-shell bark-louse, the one that is common on lilac and other ornamentals, can be controlled either by a spray of lime-sulphur or by an oil spray. If lime-sulphur is used, it should be applied in the spring, just before growth starts, at a standard strength of one part to seven of water. The efficiency of such a spray is further increased by the addition of 25 pounds of hydrated lime to each 50 gallons of spray mixture. Where one of the miscible oils is used, it should be applied at the strength recommended by the maker. Where a home-made oil emulsion is employed, one should use the same strength recommended for dormant applications in the orchard. There are so many different formulae for making home-made oil emulsions, at present, that no one safe blanket recommendation can be made. Wherever oil emulsions are to be used, precautions must be taken to prevent injury from a sudden drop in temperature. All of the oil sprays are safer if time is allowed for them to dry before freezing takes place. Otherwise injury is likely to result. In any case, whether miscible oils, emulsions, or lime-sulphur is used, the application should be made with a good pressure. Where a pressure of from 250-300 pounds is maintained at the nozzle, the results will be more likely to be satisfactory. In any case, many of the eggs will hatch, but the tiny insects coming from these eggs are incapable of traveling very far, and if the branches and trunk are well coated, they will be unable to find places to locate. That is, they will be unable to find any plaec unprotected by spray material. After traveling about for a short time they are sure to perish, because of their inability to find a suitable place to feed.

ELECTRIFYING THE KEROSENE INCUBATOR

O. E. ROBEY, SECTION OF AGRICULTURAL ENGINEERING

Last winter a test was run by the Michigan State College agricultural engineering department in cooperation with the poultry department to determine the practicability of using electricity to heat incubators which were designed to operate on kerosene.

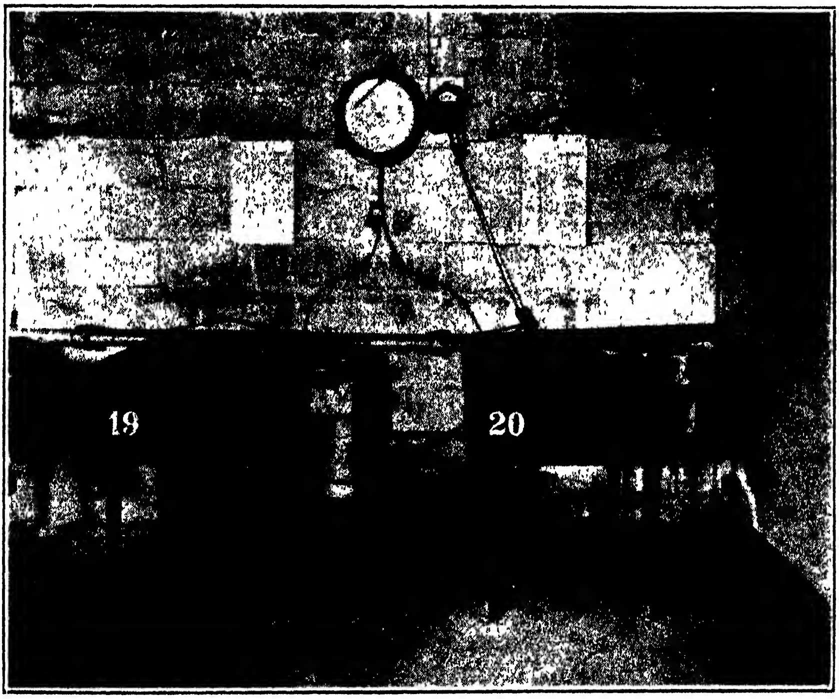
For this test, two machines were selected of the same design and capacity. They were of the hot water type, each holding one hundred eggs. The two machines were set up and run under as similar conditions as possible. A meter for recording the amount of current used was installed on the machine operated by electricity. The amount of kerosene used in the other machine was also measured. A two-pen recording thermometer kept a graphic record of the temperatures in each machine. The method of setting up the two machines is shown in Figure 1.

Very few changes were necessary to convert the one machine into an electrically heated outfit. The lamp was removed and the hot water radiator on the end of the machine was wrapped with asbestos in order to conserve as much heat as possible.

Some experimenting was necessary in order to determine the proper size

of heating unit. It was found that the ordinary heating unit commonly used in electric radiant heaters was too large. Finally, two 50-watt lamps were tried. One of these lamps was inserted at the top and one at the bottom of the housing which formerly held the kerosene lamp chimney. Factory-type lamps were found to be more convenient for this purpose. Both openings were then covered with asbestos paper.

The same thermostat that was on the machine was used to control the electric bulbs. The arm that formerly controlled the damper above the kerosene lamp was fitted with contacts so that when the incubator became too warm this lever would rise and break the circuit. When the temperature



dropped, the lever would fall and complete the circuit. Contacts from a gasoline engine spark coil were used for this purpose.

It was found that the thermostat could be adjusted so that the machine would not vary more than one degree each way from a desired temperature. A study of the temperature charts showed that the electric machine maintained a more uniform temperature than the kerosene incubator and it was better able to take care of sudden changes in room temperature.

The cost of operation of the two machines for the hatch was as follows: Kerosene—19½ pints; Electricity—24 K.W.H.; Electricity at 3 cents per K. W. H. would cost about 1½ cents per day more than kerosene but this would probably be more than offset by the reduced fire risk and the lesser amount of care required.

FERTILIZERS AID ALFALFA YIELDS ON HEAVY SOILS

Removal of Hay Depletes Supply of Phosphorus and Potash

R. L. COOK, SECTION OF SOILS

The growing of alfalfa is coming to be one of the most important phases of Michigan agriculture. Though the crop is grown primarily for hay, its value as a soil builder is also well recognized. This reputation has led some to believe that alfalfa will produce maximum yields without the use of fertilizer and that the growing of the crop leaves the soil in a much higher state of fertility than it was previously. Though this may be true with respect to the nitrogen and organic matter content, it does not hold for phosphorus and potassium. Alfalfa is a heavy feeder on these two elements and the continued removal of hay removes large quantities of these elements from the soil. It is easy then to believe that the addition of these two forms of plant food as a fertilizer would be beneficial to the crop. Experimental results show this is true.

The use of lime on heavy soils is not always necessary, since some types of soil on which alfalfa is grown are not acid. On the Brookston and Wisner types, lime is unnecessary while on Miami and Napanee soils better results are usually obtained after the application of lime. The proper method to follow is to test the soil and apply lime where it is needed.

Top Dressing Old Stands of Alfalfa

Because of the cost of alfalfa seed and the difficulty sometimes experienced in getting a good stand, the practice of growing alfalfa on the same field for several years is rather common. When this practice is followed, some provision should be made to replenish the soil with those elements of plant food which the crop removes in greatest quantities.

To find out whether the addition of these elements would result in the production of larger crops of alfalfa, several sets of fertilizer plats were laid out on different soil types. The fertilizer was applied broadcast as early in the spring as possible and was not harrowed in. The data presented in the tables show a few of the results obtained in these experiments.

The data in Table 1 show the results obtained on a Brookston silt loam. This soil has a very dark gray friable surface soil extending to a depth of about seven inches. It is well drained and not in need of lime. If only the yields are considered, it would seem that an 0-16-8 or even an 0-16-16 is the best analysis to use but when the cost of the fertilizer is considered the figures show that an 0-16-0 gave more profit than any other analysis. The 600-pound application also gave more profit than did the 300-pound application, but the results are so nearly equal that, considering the much greater investment involved, the smaller amount is to be recommended on soils of this type.

Table 1.—The effect of fertilizers on the yield of alfalfa on Brookston silt loam soil.

Plat	Treatment	Dry hay per acre, 2 cuttings 1929	Increase due to Fertilizer	Value of *Increase	Cost of Fertilizer	Profit	Loss
	Pounds	Pounds	Pounds				
101	Check	1,740	....	....	....	....	....
102	0-16-0 300	3,680	1,674	$12.56	$3 96	$8.60	....
103	0-16-8 300	4,000	1,726	12.95	5 34	7.61	....
104	Check	2,540	....	....	....	....	....
105	0-16-16 300	3,220	753	5 66	6 72	....	$1.06
106	0-16-32 300	3,920	1,527	11 46	8 88	2.58	....
107	Check	2,320	....	....	....	....	....
108	0-16-0 600	4,740	2,460	18 46	7 92	10.54	....
109	0-16-8 600	4,020	1,780	13 36	10.68	2.68	....
110	Check	2,200	....	....	....	....	....
111	0-16-16 600	5,220	2,860	21.48	13.44	8 04	....
112	0-16-32 600	3,160	810	6 08	17.76	....	11.68
113	Check	2,440	....	....	....	....	....

*In all the calculations alfalfa hay is considered to be worth $15.00 per ton. The cost of the fertilizers is calculated on the basis of $3.75 per unit for nitrogen, 90 cents per unit for phosphoric acid, $1.15 per unit for potash, and $12.00 per ton overhead cost. Profit is taken as being the value of the increase in yield minus the cost of the fertilizer. Loss is the cost of the fertilizer minus the value of the increase in yield.

Table 2 represents results obtained on Gilford loam. This is a soil which very much resembles the Brookston in topography but is a little lighter in texture and contains more lime. As a general rule, it is considerable less fertile than the Brookston soil. On this field, the plats were laid out in the spring of 1929 and fertilized as indicated, except that on the plats designated by an asterisk only 300 pounds were applied. Then, after the first cutting, the other 300 pounds were broadcast on the same plats.

During 1929, this additional application of fertilizer apparently had no effect on the yields and the 300 pounds in the spring were as good as the

Table 2.—The effect of fertilizers on the yield of alfalfa on Gilford loam soil.

Treatment	Dry hay per acre		Total	Increase due to fertilizer	Value of Increase	Cost of fertilizer	Profit due to fertilizer
	2 cuttings 1929	1 cutting 1930					
	Pounds	Pounds	Pounds				
Check	3,340	1,487	4,827	....	....	....	....
*0-16-0 600 pounds	6,220	4,062	10,282	5,948	$44 61	$7 92	$36.69
0-16-0 300 pounds	6,140	2,042	8,182	3,848	28 86	3.96	24.90
*0-16-8 600 pounds	4,820	3,907	8,727	4,887	36.65	10.68	25.97
0-16-8 300 pounds	4,900	1,820	6,720	2,880	21.60	5.34	16.26
Check	2,260	1,087	3,347	....	....	....	....
*0-16-16 600 pounds	5,450	3,885	9,335	5,547	41.60	13.44	28.16
0-16-16 300 pounds	5,120	1,731	6,851	3,063	22.97	6.72	16.25
*0-16-32 600 pounds	6,860	4,195	11,055	6,827	51 20	17.76	33.44
0-16-32 300 pounds	6,880	2,286	9,166	4,938	37 04	8 88	28.16
Check	3,160	1,509	4,669	....	....	....	....
0-16-0 600 pounds	5,320	3,773	9,093	4,555	34.16	7.92	26.24
0-16-8 600 pounds	6,580	3,241	9,821	5,414	40.61	10.68	29.93
Check	2,500	1,776	4,276	....	....	....	....
0-16-16 600 pounds	7,260	3,285	10,545	6,230	62.30	13.44	48.86
0-16-32 600 pounds	6,150	2,975	9,125	4,770	35 78	17.76	18.02
Check	3,040	1,354	4,394	....	....	....	....

*300 pounds applied in the spring of 1929 and 300 pounds after the first cutting of that year. All the other treatments were made in the spring only.

600 pounds. In 1930, however, all plats which had received 600 pounds produced very much more hay than did the 300-pound plats.

Considering the value of the increase in yield of hay and the cost of the fertilizer, it is apparent that superphosphate is all that is needed on this field. The next to the greatest profit was obtanied in the first 0-16-0 plat and there are several cases where additions of potash decreased the profit.

It can also be noticed that no consistent differences were obtained where the fertilizer was applied in two portions as compared to the total amount being put on in one application.

Considering everything, then, it seems to be proper to recommend the use of a rather heavy application of superphosphate for old stands of alfalfa on this type of soil.

Table 3.—The effect of fertilizers on the yield of alfalfa on Miami loam.

Treatment	Dry hay per acre 1930	Increase due to fertilizer	Value of increase	Cost of fertilizer	Profit	Loss
FIELD 1						
	*Pounds	Pounds				
Check	3,615					
0-20-0 500 pounds	3,929	314	$2 36	$7 50		$5 14
Check	3,763					
0-20-20 500 pounds	4,560	797	5 98	13 25		7 27
FIELD 2						
Check	2,897					
0-20-0 500 pounds	3,602	705	5 29	7 50		2 21
Check	2,565					
0-20-20 500 pounds	4,346	1,781	13 36	13 25	11	

*The average of duplicate plats

Miami loam is a type of soil which differs greatly from those already discussed. It is characterized by a grayish-brown loamy surface soil extending to a depth of five or six inches. As compared to the Brookston soil, it is rather hilly and is often in need of lime. Because of the rolling topography, it is rather difficult to lay out plats in such a way that all will be on uniform soil. The results presented in Table 3 show that fertilizer produced consistent increases in yields of hay on two fields. When the cost of the fertilizer is considered, however, the profits disappear and it seems there was a loss of the money invested in the fertilizer. This may be true but it is likely that crops following the alfalfa may be benefited enough by the fertilizer left in the soil to pay some profit on the investment.

CARROT RUST-FLY FOUND IN MICHIGAN

Insect May Become Serious Pest of Celery If It Becomes Numerous in Certain Localities

R. H. PETTIT, SECTION OF ENTOMOLOGY

The carrot rust-fly is a small, greenish fly, sparsely covered with short, yellowish hairs, and is of European origin. It was first discovered in Canada in 1885, and is a serious pest of carrot, parsnip, and celery, being also found on parsley and wild carrot. It is recorded as well on potato, turnip, and rape. It is now known to be present in a number of the north-eastern and north central states, including New York and parts, at least, of New England. It is also reported from Oregon. The injury is done in the larval stage by a small, slender, yellowish-brown maggot, measuring about one-third inch in length.

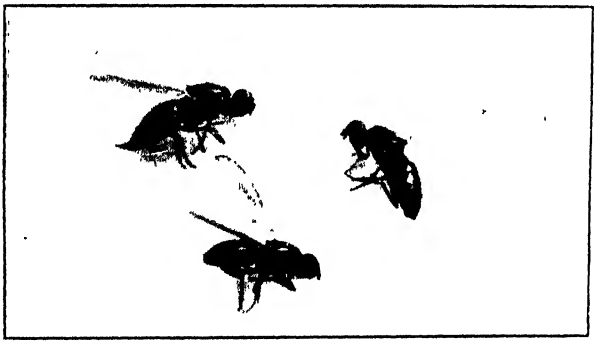


Fig. 1.—Adult of carrot rust-fly, enlarged about three times.

Character of Injury

This tiny maggot is hatched from an egg laid in a crevice in the soil or on the crown of the plant itself. The maggot works downward and eats most of the small roots before finally attacking the tap root. In the case of plants having fleshy tap roots, one finds such roots tunneled, and rendered unfit for food while, in many cases, the exterior of the root appears uninjured.

The insect passes the winter in the pupal stage, buried in the soil to a depth not to exceed six inches. The emergence of adults commences late in May and continues until early in July. Most of the flies, however, appear in early June, the females laying eggs shortly after they emerge. The larvae

Fig. 2.—Maggots of carrot rust-fly, enlarged about three times.

feed for a period of from one to two months, most of them, however, entering the soil for pupation by the middle of July.

There are two well-marked generations, the second generation appearing in early August and continuing to produce adults until early in September. It often happens that parsnips and carrots are placed in storage while they still contain maggots, and these maggots continue to work in the roots while in storage. In celery, the insect is said to eat off the roots, thus killing the plant.

This important pest of carrots and celery was discovered in Michigan for the first time at Sault Ste. Marie in June, 1914. Its work there seems to have been confined to a small area, and nothing more was heard of the insect until December, 1929, at which time specimens were sent in from Alpena, and several acres of carrots were reported as seriously injured. During December, 1930, another report, accompanied by specimens was received from Petoskey. It is to be hoped that carrots from the infested

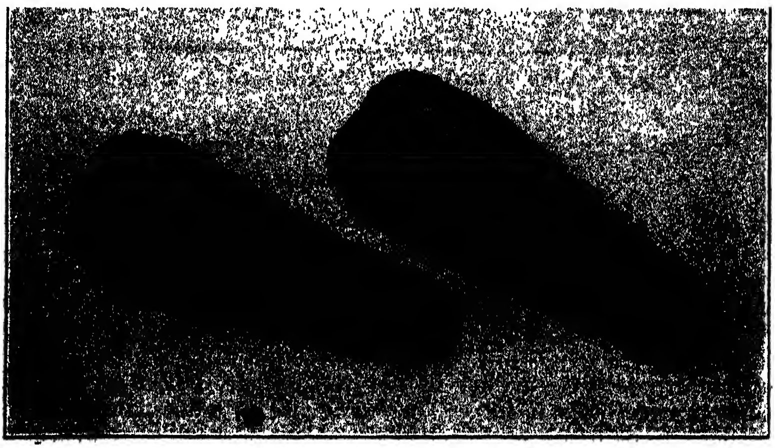


Fig. 3.—Work of carrot rust-fly in carrots.

regions will not be allowed to reach districts where celery is grown, as celery constitutes an important crop in Michigan.

Control

The destruction of wild carrots along roadsides and in fields not under cultivation suggests itself at once as a restrictive measure very much worth while. In New York, it has been found possible to dodge the broods by planting about June 1 and harvesting in early September. It has been stated that the maggots work at first on the small roots before attacking the main roots. This makes it possible to leave the carrots in somewhat longer than if the attack were made immediately on the tap root.

In case of small acreages, the treatment with 2 per cent Bordeaux oil emulsion, using several applications at intervals of one week, is said to give some measure of protection. This treatment is identical with the treatment recommended for the control of the onion maggot and consists of wetting the soil about the roots with the oil emulsion. For full directions, see Special bulletin 183.

Deep, fall plowing after the crop is harvested undoubtedly will dispose of many of the larvae and pupae in the soil. Destruction of all roots found to be infested in storage will undoubtedly take care of many more. It is to be regretted that, up to the present time, no satisfactory and practical control for the pest when working in celery or in carrots has been developed, other than that mentioned. Until such control measures are discovered, it is advisable to grow susceptible crops in districts where the maggots exist, under the most rigid, sanitary conditions.

PLOWING DEPTHS AND FERTILIZERS AFFECT SUGAR BEET CROP

Study Made Near Saginaw in 1930 Shows Efficiency of These Factors

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With the increasing use of fertilizers for the sugar beet crop, greater efforts are being made to determine the proper mixture to apply and the correct method of application to use in order to secure the best results. Very little work, if any, has been directed toward determining the effect which the preparation of the soil has upon the efficiency of the fertilizer applied.

During the fall of 1929, the section of the experimental field on the O'Keefe Farm (owned and operated by the Michigan Sugar Company), near Saginaw, Michigan, which was to be planted to sugar beets in 1930, was divided into four equal lands which were 85 feet 4 inches wide and each land was plowed to a different depth. The depth of plowing on one land ranged from 10 to 12 inches; on the next land, 8 to 10 inches, on the next, 6 to 8 inches; and on the remaining land, 4 to 6 inches. A two-way plow was used, and the soil was all turned in the same direction to avoid the formation of dead-furrows or back-furrows within the plots.

The entire section had been in a mixture of alfalfa and clover for the two seasons previous to breaking. At the time of plowing, the soil was very dry, the plowing difficult, and the soil, a Brookston silty clay or clay loam, broke up into large dry clods or lumps. No effort was made to work the soil down in the fall of 1929 but the freezing and thawing during the winter broke up the clods and left the soil in a very fine granular condition so that the preparation of the seed bed in the spring of 1930 was relatively easy and inexpensive. In the preparation of a seed bed, the lands, which had been plowed to different depths, were worked equally.

Arrangement of Plots

During the season of 1930 the entire section was used for a study of the effects of various fertilizer treatments on the sugar beet crop, this work being in cooperation with the Office of Soil Fertility. The beets were planted April 25, in rows 24 inches apart, the plots (systematically distributed)

(*The results given were obtained in connection with an extensive series of fertilizer experiments conducted cooperatively by the Michigan Agricultural Experiment Station, the Office of Soil Fertility Investigations, Bureau of Chemistry and Soils, and the Office of Sugar Plants, Bureau of Plant Industry, U. S. Department of Agriculture. Chemical analyses were made by Mr. O. B. Winter, Research Associate Chemist, Section of Chemistry of the Michigan Station.)

being so arranged that each of the various fertilizer treatments crossed each of the different depth plowings at a right angle. The fertilizer was drilled in with the seed. Each plot of beets had four rows, 85 feet 4 inches long or an area of 1/63.8 acre.

At regular intervals in the plot arrangement, a plot receiving no fertilizer treatment and designated as "check" was inserted, and the plot lying immediately next to it received an application of a complete 4-12-4 fertilizer at the rate of 300 pounds per acre. The results reported in this paper were obtained from a comparison of these fertilized plots with the adjacent checks. There were in the entire section given over to this test, 19 such complete fertilizer treatment plots, in comparison with a similar number of check plots, for each depth of plowing, in order that reliable readings could be obtained on fertilizer performance as affected by soil preparation. The various pairs of plots on the same soil treatment were separated from the

Fig. I.—Showing cracks in the soil surface in the experimental plots on the O'Keefe Farm, near Saginaw, Michigan, due to the excessive drought in the summer of 1930. (Taken September, 1930.)

next pair of plots by 24 or 32 feet and these pairs of plots were so distributed in the field as to sample the field thoroughly.

During the season, all the beets in the entire section received the same cultural treatment. The alfalfa, which was broken up in the fall of 1929, did not die out during the winter but came up after the beets were planted and proved to be a troublesome and costly weed, as in the efforts to clean the field a considerable portion of the stand of beets was lost. The alfalfa was worse on the shallower plowing than on the deeper.

The crop season of 1930 was **very dry.** Although the soil had contained a large amount of moisture when the beets were planted, this, with the meager precipitation received, was insufficient to carry the crop through the season and the yields secured were reduced accordingly. The soil became so dry that cracks extended into the soil beyond the depth of plowing. This cracked condition of the soil surface is shown in Figure 1.

Fig. II.—Lifting sugar beets, two rows at a time. (Taken October 1930.)

The beets were harvested during the last few days in September and the first few days in October. At the time of harvest, the soil was so dry that ordinary harvesting implements could not be used. Harvesting was finally very satisfactorily accomplished by using a No. 15 Killefer tillage implement equipped with a steel plate 8 inches wide and 18 inches long bolted across the point.* This implement, pulled by a caterpillar-type tractor, lifted two rows at once. Figure II shows the implement at work, and Figure III the appearance of the soil after the beets had been removed.

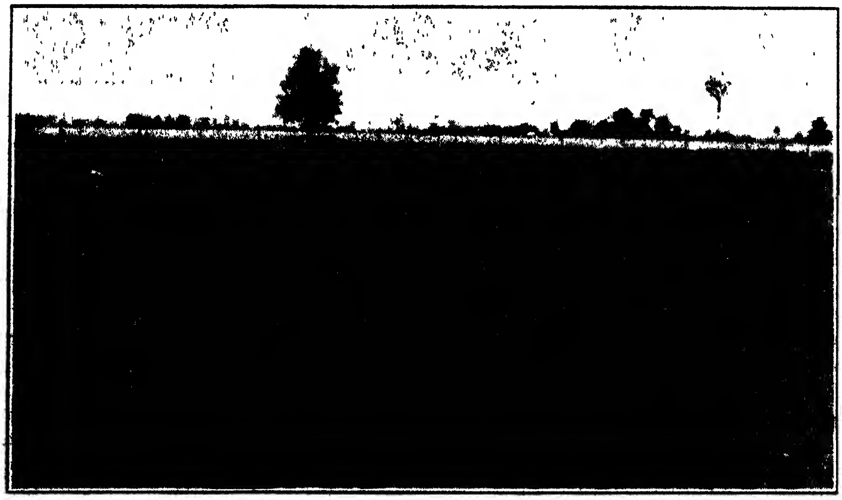

Fig. III.—Condition of field after beets were harvested. (Taken October, 1930.)

(*This was improvised as the regular Killefer beet-lifting attachments were not available.)

After the beets had been lifted, they were pulled, piled, and topped. The beets from each plot were piled separately, then counted, weighed, and samples taken for analysis.

The following Table gives the summary of data secured from these nineteen pairs of plots both fertilized and unfertilized on the different depths of plowing.

Summary of the data secured from the nineteen pairs of fertilized and unfertilized plots on the various depths of plowing.

The soil was plowed from	Without fertilizer		With fertilizer 300 pounds 4-12-4 per acre		Difference or actual increase of fertilized plots over unfertilized plots	P. E. of difference	Difference divided by its P. E.	Per cent increase of fertilized plots over unfertilized plots
	Mean	P E	Mean	P. E.				
THE NUMBER OF COMMERCIAL ROOTS PER ACRE								
10 to 12 inches	9,543	230	15,450	203	5,907	306 7	19.2	61.90
8 to 10 inches .	10,285	249	16,581	190	6,296	313 2	20.1	61 22
6 to 8 inches	10,631	297	15,678	209	5,047	363 1	13 9	47.47
4 to 6 inches	12,246	273	16,047	139	3,801	306 3	12 4	31 04
THE YIELD IN TONS PER ACRE								
10 to 12 inches ..	5 722	123	9 990	070	4 268	142	30.1	74.59
8 to 10 inches	6 229	129	10 891	109	4 662	169	27 6	74 84
6 to 8 inches .	6 630	157	10 893	109	4 254	.191	22 3	64 08
4 to 6 inches	6 634	167	9 971	105	3 337	.197	16 9	50 33
THE SUCROSE CONTENT OF THE SUGAR BEETS SECURED								
10 to 12 inches . .	18 78	1288	19 42	0780	0 64	1505	4 3	3.41
8 to 10 inches. . ..	18 75	1303	19 63	0810	0 88	1534	5 7	4 92
6 to 8 inches	19 48	1397	19 65	1976	0 17	2420	..	0 87
4 to 6 inches .	19 14	1181	19 02	1130	−0 12	1634	.	−0 63
THE PURITY COEFFICIENT DETERMINED FOR THE SUGAR BEETS SECURED								
10 to 12 inches .	87 00	1729	86 79	1554	−0 21	2325		−0.24
8 to 10 inches . . .	87 05	3266	86 71	2202	−0 34	3939		−0 39
6 to 8 inches.. .	86 91	2258	87 14	2155	0 23	3121		0 26
4 to 6 inches	87 23	.1678	87 01	2578	−0 22	3076	. .	−0 25
THE POUNDS OF SUGAR PRODUCED PER ACRE								
10 to 12 inches	2,149	50	3,880	31	1,731	58 8	29 4	80 55
8 to 10 inches . . .	2,337	56	4,275	52	1,938	76 4	25 4	82.93
6 to 8 inches	2,586	70	4,282	44	1,696	82 7	20 5	65 58
4 to 6 inches. . . .	2,539	65	3,792	48	1,253	80 8	15 5	49 35

General Results

Analyzing the data secured, a significant increase in number of commercial roots harvested per acre is seen in favor of the fertilized beet plots. This actual increase is consistent with the fertilizer application. Since "stand" or the number of beets grown to the acre is of great importance

in realizing large tonnage yields, other things being equal, this increase in stand is of commercial value.

In spite of dry weather and the lack of sufficient soil moisture during the summer and early fall of the year, the tonnage yield was influenced favorably by an application of commercial fertilizer. This increase was materially affected by the depth of plowing, the actual increase being especially significant in the intermediate plowings. Eight to ten inch plowing is generally advisable where previous handling of the soil permits this practice. The 10 to 12 inch plowing was disadvantageous this year under the conditions of this test.

In regard to sugar per acre yield, this is strikingly in favor of the fertilized plots. Here too, the intermediate plowing depths were productive of best results. The fact that these yields were increased by 1,253 pounds and up to 1,938 pounds more sugar to the acre, in a dry year, in fertilized beet plots, as compared with the unfertilized beet plots, is a striking demonstration of the value of proper fertilizer usage.

Sucrose content of beets, and the purity coefficient of the juice are of exceedingly great importance to the beet sugar industry. The fact that the higher yielding fertilized crop held its own in this respect, in comparison with the lower yielding unfertilized crop, is an added argument in favor of rational fertilizer usage and the increased efficiency of same by proper soil preparation.

Discussion of Results

With but two exceptions, the crop produced with fertilizer was more uniform throughout, than the crop produced without fertilizer. This increase in uniformity is especially striking in the case of the number of commercial roots and the yield secured per acre. With the amount of sugar produced per acre, the increase in uniformity though less, is of great importance. Considering sucrose content, the results secured from the fertilized beet plots were more uniform than the results secured from the unfertilized beet plots.

That the productive power of the soil was considerably modified by the depth to which it was stirred is clearly shown by the data in the preceding summary. Without fertilizer, the number of commercial roots varied from 9,543 to 12,246 per acre, the yields secured varied from 5.722 to 6.634 tons per acre, the sucrose content of the sugar beets varied from 18.75 to 19.48 per cent, the purity coefficient of the sugar beets varied from 86.91 to 87.23, and the amount of sugar produced per acre varied from 2,149 to 2,586 pounds. Further, it is of interest to note that, in the case of the unfertilized plots, the highest number of commercial roots, the next to the highest yield per acre, and the next to the highest amount of sugar produced per acre were obtained from the shallowest plowing. It is appreciated that seasonal conditions were greatly responsible for this contrast because, in years of abundant rainfall, the deeper plowings will generally give better results than the shallow plowings.

The application of the fertilizer did not produce the same actual increase in every factor obtained for the various depths of plowing. The tendency of the fertilizer, as shown by the actual increases secured, was to cause a more uniform production no matter what the preparation of the soil had been. The effect of the fertilizer was not only to increase the crop produced in all cases, but to increase it to almost the same point irrespective of the amount that the soil could have pro-

duced without fertilizer. As stated previously, the season was very dry and it is recognized that the yields secured were depressed by the lack of moisture.

The last column of the summary table shows the percentage increases secured by the use of fertilizer. The percentage increases for the number of commercial roots produced, the yield secured, and the number of pounds of sugar produced per acre were greater, the deeper the soil was stirred. Since the soil had, under the various treatments, the differing ability to produce, the greatest actual increase secured in each of the above cases does not coincide with the greatest percentage increase. The greatest actual increase in each of the above cases was secured when the soil was plowed to a depth of 8 to 10 inches, or the depth to which it had normally been plowed previously.

The quality of the sugar beet roots produced was affected in a somewhat different manner by the fertilizer applied. In the first place, the application of the fertilizer did not affect the quality of the roots to nearly the same extent that it did the number and quantity. In the second place, the application of the fertilizer caused an increase in the sucrose content of the beets in three out of the four cases while an increase in the purity coefficient was caused in but one case out of the four. This effect of the fertilizer upon the quality of the roots is probably due to the fact that with the application of the fertilizer, a better balance was established in the soil among those several mineral elements which the sugar beet plant uses in its growth.

Conclusions

Under the soil and seasonal conditions for the crop season of 1930, the following points are indicated:

1. The use of the fertilizer resulted in a much greater uniformity in the crop produced.
2. The stirring of the soil to the several depths varied the producing power of the soil to a noticeable degree.
3. The producing power of the soil was greatly increased by the application of the fertilizer.
4. While the **percentage increase** in the number of commercial roots, yield secured, and in sugar produced per acre became greater the deeper the soil was stirred, the greatest **actual increase** as to number of roots, produced, the yield secured, and the pounds of sugar produced per acre was obtained from fertilized soil that had been stirred 8 to 10 inches deep.
5. The sucrose and purity percentages throughout both the fertilized and unfertilized series, various depths of plowing considered, fluctuated within narrow limits but with a very definite trend in favor of fertilizer application and deeper stirring of the soil.
6. The sugar per acre figures, being determined from yields and sucrose percentages, show definitely the marked gain from use of proper fertilizer treatments coupled with adequate soil preparation.

NEED QUACK GRASS CONTROL IN POTATO FIELDS

This Weed Severely Reduced Yields of Marketable Tubers in Lake City Fields

ASHLEY BERRIDGE, LAKE CITY POTATO EXPERIMENTAL STATION

Quack grass control is one of the most important problems facing many central and northern Michigan potato growers. The effect of non-control on quality and yield per acre has been demonstrated clearly at the Potato Experiment Station near Lake City. The eradication of this weed from the four forty-acre fields where potatoes are grown on this farm has become its first important problem.

Fig. 1.—South end of Russet Rural Plot. Planted on soil relatively free from quack grass. Yield 163.3 bushels per acre.

The first, or 1929, crop of potatoes grown at the Station was planted on a quack grass meadow directly after plowing. The seed bed was prepared by disking, no dragging being done until after planting. Repeated cultivations, ridging, and hand hoeing were necessary to control the quack grass and, even then, on the lighter portions of the field, the yield was cut heavily. The 1930 field for potatoes was plowed in August and late fall of the year before. The seed bed was prepared by dragging and disking twelve times. The special quack grass drag and the disk harrow were kept sharp at all times and weed control was much easier than in 1929.

A striking demonstration of the effect of poor quack grass control was noted in 1930 on two small plots of early planted potatoes. They were planted on the part of the field last plowed in the fall. A strip of quack grass pasture that had not been plowed for years ran across the north end of both of these plots. The remaining ground had been cultivated more recently. The plots were leveled off in the spring by three draggings and immediately planted. One acre of Russet Rurals was planted on May 6 with a horse planter. The hills were 17 inches apart in rows 36 inches apart. Six hundred pounds per acre of 4-16-8 commercial fertilizer were applied in the row. On May 9, one-half acre of Irish Cobblers was planted in the same way. The north one-third of each of these plots extended over the quack grass pasture. The plots were sprayed and cultivated alike throughout the season but

Fig. 2.—North end of Russet Rural Plot. Planted on quack grass sod. Yield 67.6 bushels per acre.

no hand hoeing was done. The accompanying illustrations show the contrast in vine growth of the quack grass infested plot (Fig. 1) and the plot which was relatively free of quack grass (Fig. 2).

On August 11, two 100 feet rows were dug in different parts of the Cobbler plot. One-half of each row was from the clean area and the other half from the quack infested area. The U. S. No. 1 potatoes were graded out and those remaining were classed as sorts. In September, the Russet Rurals were dug and graded in the same way. The average yields per acre are recorded in Table 1.

It will be noted that the yield of Irish Cobblers of the U. S. No. 1 grade on the clean plot was two and one-half times more than the yield on the area infested with quack grass, while corresponding yields of the Russet Rurals were as ten to one. Differences in the yields of culls produced under the two conditions were relatively small, but the producer is interested primarily in the production of table stock grade. At average prices paid for this grade of potatoes, the grower would

Table 1.—Average yield per acre of U. S. No. 1 potatoes and of a poorer grade classed at sorts.

	Irish Cobblers			Russet Rurals		
	U. S. No 1 bushels	Sorts bushels	Total Yield bushels	U. S. No.1 bushels	Sorts bushels	Total Yield bushels
Clean of Quack grass	154 8	45 9	200 7	100 4	62 9	163 3
Infested with Quack grass . . .	61 7	48.4	110 1	10 8	56 8	67 6

be ahead to let quack grass infested land lie idle for a year before planting and by means of repeated cultivations entirely eradicate the weed.

Samples of the soil were taken at the time the Cobblers were dug and moisture determinations were made. The average percentage of moisture in the clean soil was 4.78 and in the soil infested with quack grass it was 2.16. This was in middle August during a severe drought. Considerable rainfall came just before the digging of the Russet Rurals and prevented obtaining corresponding figures for that plot. It was evident, however, from these soil moisture determinations and from the wilted appearance of the potato tops during the middle of the day near the end of the drought period that the quack grass exerted a considerable part of its harmful influence through robbing the potatoes of their moisture supply.

MOORE EARLY GRAPE NOT RECOMMENDED FOR MICHIGAN

NEWTON L. PARTRIDGE, SECTION OF HORTICULTURE

A study of the fruiting habits and pruning of the Moore Early grape conducted by the Section of Horticulture shows that the production of this variety is too meager to justify its planting in commercial vineyards in Michigan. Various types of pruning have been practiced and a rather comprehensive study of the fruiting habits of this variety have been made. None of the types of pruning practiced have given profitable yields during the period of this test, as shown in Table 1.

The largest yields are reported for the vines which were pruned the least. However, this treatment reduced the vigor of the growth to such a degree that light pruning could not be continued longer. It is evident that these vines cannot return a profit to the grower except during periods when the fruit can be sold at abnormally high prices.

The vines studied were growing on a soil which is rather more productive than most vineyard soils in Michigan. The owner has applied some fertilizer nearly every year and the general soil management is

Table 1.—Grapes Harvested, in Tons per Acre.

	Light pruning (60 buds)	Moderate pruning (40 buds)	Severe pruning (30 buds)
1928	1 6	0 8	0 7
1929	2 0	1 4	1 0
1930 .	*0 5	0 6	0.5
Average...	1 4	0 9	0 7

*These vines were pruned to 40 buds in 1930

at least as good as that found in the majority of commercial vineyards. Though it has not been shown that reasonable yields may not be secured on rich soils with heavy applications of fertilizers, no productive Moore Early vineyards have been observed in the state. Consequently, the planting of this variety in commercial vineyards cannot be recommended.

CALIFORNIA CLINGSTONE PEACHES ARE UNSUITABLE HERE

STANLEY JOHNSTON, SECTION OF HORTICULTURE

Due largely to the proximity of satisfactory fresh fruit markets and their demand for peaches of the freestone type, Michigan peach growers have grown freestone varieties almost exclusively. The fruit canners of the state have packed limited quantities of some of these varieties, such as Kalamazoo, Gold Drop, Lemon Free, Banner, Smock, and Salwey. The product, however, has usually been discriminated against in the market, higher prices being paid for peaches canned in California. This has been because peach growers and canners of that state found long ago that peaches of the clingstone type not only make a much better appearing canned product than the freestones, but that they are also a more satisfactory type to grow and handle prior to canning. With the development of their extensive canning industry, which now supplies approximately 98 per cent of the commercial peach pack in the United States, they have produced a large number of desirable clingstone varieties.

About 1922, several of the Michigan fruit canners became interested in packing clingstone peaches. The section of horticulture of the Experiment Station was requested to find varieties suited to Michigan. It was natural to turn to California for varieties of this type and, accordingly, a number were brought to the South Haven Experiment Station for trial. These included Phillips, Tuscan, Paloro, Johnson, Peak, Orange, Albright, McDevitt, Sims, Levi, Florence, Sellers, Yellow Swan, and Hansen. Growth and production characteristics under Michigan conditions were determined, and, through the co-operation of the South Haven Preserving Company, a unit of Michigan Fruit

Canners, Incorporated, their fruit was given a commercial canning test. Without exception, they proved unsatisfactory in one respect or another. All but Johnson have remained very unproductive under conditions in which the varieties ordinarily grown in this state yielded heavily. Large trees of Phillips, Tuscan, and Paloro, the three leading varieties in California, have produced only a dozen or so fruits per year. Though trees of the Johnson, a comparatively new variety in California, have been productive at the South Haven Station, the fruit did not have an attractive color when canned. The trees of nearly all of these varieties were not particularly vigorous.

Sufficient evidence has been obtained to indicate that the clingstone varieties now being grown in California are not suited to Michigan conditions and that it is likely that the development of an important clingstone peach canning industry in Michigan must be based on the discovery of new varieties presumably bred especially to meet Michigan conditions.

USE HIGH TEMPERATURES TO PASTEURIZE ICE CREAM MIX

Tests Show Some Bacteria Survive Treatment at Usual Temperatures for Pasteurization

F. W. FABIAN, SECTION OF BACTERIOLOGY

Recent experiments have shown that the ice cream mix may be pasteurized at considerably higher temperatures than has been commonly used in the past without any deleterious effects upon the physical properties of the mix or upon the flavor of the ice cream. In view of this fact, experiments were conducted to ascertain the effect of these higher pasteurizing temperatures on certain bacteria, *Escherichia coli,* sometimes found in ice cream.

Plan of Experiments

In making the tests, the bacteria were grown for 24 hours at body temperature, after which a definite amount of the culture was introduced into a tube of sterile ice cream. A tube so treated was then heated for 30 minutes in an electrically heated and carefully controlled water bath. The temperatures used were 140, 145, 150, and 155° F. At the end of the 30 minute heating period, the tubes were tested for growth. To be certain that the bacteria were killed, the original tubes were kept for several days and retested. In this way, it was possible to determine more accurately the viability of the bacteria in the ice cream.

What Experiments Showed

The results secured from the series of experiments were very interesting. The first temperature used was 140° F. As previously stated, four tests were conducted at this temperature. On the first trial of the 41 cultures tested, 21, 51.2 per cent, of them survived. Sixteen, 29.0 per cent of the 41 cultures, survived the second trial. In the third trial, only 25 cultures were tested of which nine, 36.0 per cent, survived. On the fourth trial, 25, 57.0 per cent of the 44 cultures, survived.

The temperature then was raised to 145° F. and the experiment was repeated. The results are quite different from those secured at 140° F. The results secured at 140, 145, and 150° F. are tabulated for the sake of clarity and brevity.

Table showing results of four trials on the viability of different strains of Escherichia-Aerobacter bacteria when heated in ice cream at different pasteurizing temperatures.

Trial Number	Total Number cultures heated	Number killed	Number surviving	Per cent surviving
140° F. for 30 Minutes				
1	41	20	21	51 2
2	41	25	16	29 0
3	25	16	9	36 0
4	44	19	25	57 0
145° F. for 30 Minutes				
1	44	34	10	22 7
2	44	41	3	6 8
3	44	43	1	2 2
4	44	34	10	22 7
150° F for 30 Minutes				
1	40	40	0	0
2	41	40	1	2 4
3	41	40	1	2.4
4	44	40	4	9.1

When the temperature was increased to 155° F. and the experiment repeated, all the cultures were killed in all four trials.

Influence of Different Ingredients

Since certain strains were not readily killed at the temperature commonly employed in pasteurizing ice cream, it was thought advisable to determine whether one constituent in ice cream had a greater protective action for the bacteria than any other. Accordingly, concentrations of the various ingredients in the percentage range used in making ice cream were tried. The same technic was used as with the ice cream.

The first constituent tried was butter fat in the form of cream. The percentages used were 8, 10, 12, 14, and 16. When the tubes were seeded

with the most resistant of the bacteria and heated at 140° F. for 30 minutes, all were killed. This trial showed that butterfat alone had no protective action.

Skim milk powder in 1, 2, and 4 per cent concentrations showed a slight protective action for some strains of the bacteria at 140° F. but all were killed at 145° F.

Sucrose was made up in 10, 12, and 14 per cent concentrations and seeded with resistant strains of the bacteria in question. At 140° F., three cultures out of the nine tested, or 35 per cent, survived but at 145° F. all were killed.

Gelatin emulsions ranging from 0.2 to 1.0 per cent, in 0.1 per cent gradations, were tested. Every culture tested at 140° F. was killed. The pH of most of the samples was sufficient to kill the cultures with a moderate degree of heating.

As far as our results showed, no single ingredient exerted any great protective action on the bacteria. However, the picture was different when all the ingredients were combined, processed, and made into ice cream.

Significance of the Results

The results secured show that by increasing the temperature of pasteurization to 155° F. that presumably all bacteria of this type will be killed.

THINNING FOREST PLANTATIONS PROMOTES GROWTH

Taking Out Weaker Trees Permits Stronger Specimens to Utilize Space and Soil

R. H. WESTVELD, SECTION OF FORESTRY

Cuttings which are made in young stands of timber are usually referred to as thinnings. The purpose of thinnings is to give more space for growth to the promising trees which, because of the overcrowded condition of the stand, are growing very slowly and which may be stagnated in extreme conditions. Such a condition often exists in plantations where the trees have been planted close together in order to get a cover on the ground rapidly and to develop straight trees free of large limbs.

During the early life of a plantation, crowding of the trees is desirable, but as the trees become larger some of them become so crowded that they lose their vigor and eventually die, the more vigorous ones are greatly slowed down in growth. The age at which this condition occurs will depend primarily on the spacing of the trees and on their rate of growth. Trees spaced six feet apart will become crowded at an earlier age than trees spaced eight feet apart. The first thinning can usually be made between the fifteenth and twentieth years if the trees

are spaced six feet apart. A thinning was made in a Norway pine plantation at the College when the trees were 21 years of age. At that time, the trees were badly crowded and some were already dead. A plantation of western yellow pine was thinned at 18 years. Many of the trees removed in the thinning were growing very slowly but very few were dead.

Details of Thinning

The usual practice in thinning a plantation is to remove the trees which are small and badly crowded. Removal of these trees results in utilizing the unthrifty individuals before they die and at the same time releasing some space for the larger well developed trees. The material which is cut is of small size under such a method of thinning. In the Norway pine plantation at the College, the average size of the trees removed was approximately five inches in diameter at breast height while, in the western yellow pine plantation, the size was slightly over three inches.

In thinning a forest plantation, care should be taken that the stand is not opened up too much. Too heavy thinning is likely to make the trees subject to windthrow or wind breakage. Furthermore, soil is likely to deteriorate. The degree of thinning will have to be varied with the age and condition of the stand. In the red pine plantation at the College, 36 per cent of the trees were cut. This represented 28 per cent of the total volume of the stand. Such heavy thinning was necessary because the trees were large and thinning was being done at a rather late age. Ordinarily removal of such a large volume would not be advisable. Good results were obtained in the western yellow pine plantation by removing 24 per cent of the number of trees which represented 12 per cent of the total volume. Moderate thinnings should ordinarily remove from 20 per cent to 30 per cent of the trees which would be 10 per cent to 20 per cent by volume.

In case some fairly good size material is desired from the thinning, a few of the large trees can be removed and some of the thriftiest small trees can be left. Care is necessary, however, because the removal of large trees may open up the stand too much. In selecting any large trees for cutting, those individuals should be selected which have the least promise of developing to good advantage in the future. In other words, trees of poor form or otherwise defective should be selected for removal. Some material six or eight inches in diameter can be secured by such thinning.

Frequent light thinnings are more desirable than occasional heavy thinnings. As soon as the crowns become closed and any of the trees show signs of reduced vigor, thinnings are in order. The interval between thinnings may be anywhere from five to ten years, more often the latter, but that will depend on the severity of the previous thinning.

In any type of thinning, the trees removed should be those which have the least possibility of future value. Through such consideration, trees which might die will be salvaged and a maximum growth of high quality will be produced on the remaining stand.

Results Attained by Thinnings

The primary object of thinning is to increase the rate of growth of the more promising trees which are left. The thinned plots at the

College were thinned only two years ago so that no data are available on the growth of these stands after thinning. It is generally recognized, however, that thinning does increase the growth rate. An example of the effect of thinning on the rate of growth of white pine in southern New Hampshire* will serve to illustrate what can be reasonably expected. The rate of growth on a heavily thinned plot was 8.6 per cent, on a lightly thinned plot 7.8 per cent, and on the unthinned plot 5.7 per cent per annum. The growth of the thinned plots is based on the volume after thinning and that of the unthinned plot on the total volume.

In addition to increasing the rate of growth of the remaining stand, thinnings salvage material which would otherwise be lost through death and eventual deterioration. Although the material removed is small in size, it is a convenient size for cordwood. Occasionally the material can be used for posts or poles for special purposes. It is rather surprising how much material can be cut from these young stands. The Norway pine plantation at the College, which was thinned in 1928, produced approximately eight cords per acre at 21 years. The western yellow pine plantation, which was thinned less heavily in 1930, produced 2.5 cords at 18 years.

A small part of the material removed from the thinnings was disposed of as split poles at a net profit of approximately $10 per cord. The remainder of the product was disposed of as fuel-wood at a net profit of approximately $1 per cord. Thinnings, therefore, can be made at a profit to bring in an intermediate return while the main crop is still growing. At the same time, the remaining stand is greatly improved.

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*A Second Progress Report of the Results Secured in Treating Pure White Pine Stands on Experimental Plots at Keene, New Hampshire. R. C. Hawley, Yale University, School of Forestry, Bulletin 20, 1927.

DAIRY CATTLE DO NOT NEED COMPLEX MINERAL MIXTURES

Equal Parts Special Steamed Bone Meal and Salt Will Correct Deficiencies in Ration

C. F. HUFFMAN, SECTION OF DAIRY HUSBANDRY

Since the skeleton, the calves, and the milk of the dairy cow are high in mineral elements, especially calcium and phosphorus, the assumption has been made that commonly used rations although properly balanced from the standpoint of protein and energy are deficient in these minerals, especially calcium. The need for extra minerals or mineral supplements in the ration of heavily producing cows has been stressed and a lack of calcium and phosphorus has been used to explain many troubles encountered with high producing cows. As a result of the widespread assumption that well balanced rations from the standpoint of protein and energy do not furnish sufficient minerals, many commercial mineral mixtures for which fabulous claims are made have been placed on the market. It was claimed that mineral supplements would promote growth and milk production in cattle and that abortion and sterility would be cured by these mixtures.

In the fall of 1922, the section of dairy husbandry of the Michigan Agricultural Experiment Station initiated a long time mineral feeding experiment to investigate the mineral requirement, more especially for calcium and phosporus, of dairy cattle and to determine the effect of bone flour, calcium carbonate, raw rock phosphate, and a complex mineral mixture on the growth, reproduction, milk production, and health of dairy cattle when a basal ration of timothy hay, corn silage, and grain was used. The grain mixture consisted of corn, oats, and cottonseed meal to first freshening and linseed meal in place of cottonseed meal thereafter. Also, one lot of animals on the basal ration were turned on pasture in season. Another lot was fed alfalfa in place of timothy and the ration was balanced by reducing the protein concentrate.

The results of this investigation showed that a ration of timothy hay, corn silage, and grain contained ample minerals for growth. The use of bone flour or calcium carbonate in the form of ground limestone rock had very little, if any, effect on growth. The extra calcium furnished by alfalfa hay also failed to stimulate growth. In other words, rations for growing cattle balanced from the standpoint of protein and energy, containing silage and ample hay of good quality, furnish enough calcium for normal growth without the addition of calcium as a mineral supplement.

Since milk contains 0.10 per cent calcium and 0.09 per cent phosphorus, it is evident that the heavy milking cow requires more of these

elements than the growing animal. As a matter of fact, these two minerals are usually regarded as the mineral elements most likely to be deficient in the ration of dairy cattle. In our long time mineral feeding experiment, milk records were kept on each individual animal. The results for 305-day lactations are shown in the following table.

Table I.—Showing Milk and Fat Production (305 days per lactation)

	Animal Number	1st lactation		2nd lactation		3rd lactation	
		Milk, lbs.	Fat, lbs.	Milk, lbs.	Fat, lbs.	Milk, lbs.	Fat, lbs.
Group I.	M 218	11,220	311	14,648	392	12,485	364
Ration:	M 234	9,026	295	10,034	334	9,143	313
Timothy	M 238	5,316	156	5,660	147	5,600	169
Silage	M 242	10,170	340	10,141	338	...	...
Grain	M 281	8,614	277	9,021	296	8,743	321
Mineral Supp., None	Average	8,869	276	9,901	301	8,994	292
Group II.	M 213	7,797	242	10,503	354	Killed, cystic ovaries	
Ration:	M 214	8,262	233	8,183	223	9,600	241
Alfalfa	M 216	7,815	254	9,260	283	Killed, injured udder	
Silage	M 217	10,569	330	9,011	252	8,969	268
Grain	M 257	6,528	193	5,363	177	6,223	196
Mineral Supp., None	Average	8,194	250	8,464	258	...	...
Group III.	M 258	8,342	273	8,566	272	10,176	322
Ration:	M 259	7,455	256	8,713	295	10,645	354
Timothy	M 260	9,502	353	8,505	306	Killed, foreign body in heart	
Silage	M 264	7,396	221	7,593	235	Killed, severe udder infection	
Grain	M 266	7,387	260	8,048	271	9,708	327
Pasture in season	Average	8,016	273	8,285	276	...	...
Mineral Supp., None							
Group IV.	M 222	8,196	269	10,214	336	12,204	414
Ration:	M 227	10,516	329	9,067	270	9,646	308
Timothy	M 236	7,277	209	9,624	257	8,366	267
Silage	M 240	9,444	309	9,204	299	10,318	335
Grain	M 253	7,343	223	8,873	270	10,837	348
Mineral Supp., Bone Flour	Average	8,555	268	9,396	287		...
Group V.	M 221	5,223	172	5,244	145	5,103	140
Ration:	M 235	7,639	251	7,227	225	8,443	275
Timothy	M 239	6,568	226	5,122	165	7,621	265
Silage	M 243	8,050	216	7,792	246	6,221	193 (225 days)
Grain	M 256	5,326	160	6,667	208	6,176	194
Mineral Supp., Raw Rock Phos., Limestone Rock	Average	6,561	205	6,410	199	...	...
Group VI.	M 220	5,033	154	Died	...	...	...
Ration:	M 228	Died	...	...	...	...	...
Timothy	M 241	5,560	185	5,776	203	5,784	210 (201 days)
Silage	M 244	3,166	114	4,746	173	3,878	141 (123 days)
Grain	M 252	5,946	178	6,036	177	7,722	226
Mineral Supp., Complex Mineral Mix	Average	4,926	158	5,519	185	...	...
Group VII.	M 329	9,387	341	12,089	418	...	...
Ration:	M 332	6,579	233	...	...	...	...
Timothy	M 333	8,463	295	...	...	...	...
Silage	M 335	11,318	328	12,204	363	...	...
Grain	M 334	6,037	219	5,558	194	...	...
Mineral Supp., Limestone Rock	Average	8,357	283	9,950	323	...	...

The difference in milk production among groups I and IV was not great enough to overcome individual variation when factors such as udder infection, abortion infection, or retained placenta are taken into consideration. Additional calcium in the form of bone flour, alfalfa

hay, pasture, and limestone rock did not increase milk production above that obtained with a ration consisting of timothy hay, silage, and grain. One animal in each of the first four groups was kept until after completing a fourth lactation. The 305-day milk production of these four cows for the fourth lactation is shown in the following table.

Table II.

Group	Animal Number	Ration	Mineral Supplement	Milk Production
I.. . . .	M 218 ..	Timothy hay, silage, grain .	None .	13,252 lbs.
II....	M 217.	Alfalfa hay, silage, grain	None	12,252 lbs.
III.	M 266	Timothy hay, silage, grain	Pasture . .	12,627 lbs.
IV. . .	M 222...	Timothy hay, silage grain	Bone Flour .	14,635 lbs.

During four 305-day lactations, M 218 in group I on a low calcium ration produced 51,605 pounds of milk, M 217 in group II produced 40,976 pounds, M 266 in group III produced 37,170 pounds, and M 222 in group IV produced 45,249 pounds of milk. In all probability, the difference in milk production of these cows can be explained on the basis of individual variation, due to inheritance, udder trouble, retained placenta, or other factors. The milk production of Group V which received raw rock phosphate and limestone rock and that of group VI which received a complex mineral mixture was below that of the check group. This was likely due to the effect of these mineral supplements on the health and the teeth of the animals.

Earlier experimental work indicated that cows producing more than 10 pounds of milk daily were losing calcium from their bodies. In this investigation, calcium and phosphorus balances were determined for groups I, II, III, IV, and VII during heavy production, medium production, and periods when the cows were dry. The cows in group I, on the basal ration without any mineral supplement, were usually losing calcium when producing more than 60 pounds of milk daily, but when dry or when producing up to 40 pounds per day they stored a sufficient quantity of this element for the production of at least 10,000 pounds of milk a year. During heavy production, these cows used about 50 per cent of the food calcium for milk production. This efficient utilization is far greater than was formerly believed, which again shows how economically the dairy cow can produce human food.

When alfalfa hay, silage, and grain were fed, most of the calcium balances were positive even during heavy milk flow. This shows the fallacy of supplementing such a ration with mineral supplements which supply calcium.

The group receiving bone flour as a supplement to a ration of timothy hay, corn silage, and grain were also usually on positive calcium and phosphorus balances during high production. M 253 was on a calcium and phosphorus balance when producing 80 pounds of milk a day.

These cows were slaughtered at the end of five years and their bones were examined for specific gravity and breaking strength. Post morten examinations showed that these cows had not suffered. The bones of the cows used in this investigation were apparently normal even when the basal ration which was low in calcium was fed.

The level at which minerals were fed in this experiment had no effect on the number of services required for each conception. The length of gestation was not materially affected by the ration.

It is common opinion that a lack of calcium or phosphorus or both in the rations lowers the resistance of the animal body so that it becomes more susceptible to infection which causes abortion, especially contagious abortion. The animals in this experiment had ample opportunity to become infected with B. abortus as they were kept in the same barn and were turned in a dry lot for exercise each day with animals which were positive to the blood test. The results have been substantiated by an extensive experiment at the University of Wisconsin.

Rations fed to dairy cattle in Michigan which are sufficiently low in phosphorus to produce depraved appetite, which is shown by the chewing of wood, bones, or other foreign matter, do not affect reproduction adversely.

Phosphorus is more likely to be deficient in the ration of dairy cattle than any other mineral element because roughage, the natural food of the cow, is low in this element. Consequently, in regions where phosphorous is deficient in the soil or for some reason is not available to the plant, phosphorus deficiency is likely to occur when the ration is made up of legume hay or pasture which are supplemented by cereal grains which are also low in phosphorus.

A ration consisting of alfalfa hay and cereal grains balanced from the standpoint of energy and protein may not contain sufficient phosphorous. Several years ago while investigating the cause of depraved appetite, an observation was made that the animals most affected were milking cows fed on alfalfa and corn and oats. This was also observed among cows on good sweet clover pasture, supplemented with corn and oats. However, in the same regions, cows which were fed alfalfa hay and corn and oats, supplemented with a protein concentrate such as linseed oil meal, cottonseed meal, corn gluten feed, or wheat bran were not affected. Protein concentrates are usually rich in phosphorus. Bone meal mixed with equal parts of salt or with grain also prevented and cured the phosphorus deficiency.

This problem is being investigated further by the section of dairy husbandry. Fourteen heifers are being used to determine the phosphorus requirement for growth, reproduction, and lactation.

In our long time experiment, one group of animals received a cheap mineral supplement consisting of equal parts ground limestone rock and raw rock phosphate. The results of this investigation showed that the feeding of raw rock phosphate affected health adversely and also affected the bones and teeth of the animals when the mixture was fed as 1.5 per cent of the grain mixture. The teeth became badly worn. The jaw bones were also thicker than normal. Later investigations by the section of dairy husbandry have shown that the mineral element fluorine is the harmful factor in raw rock phosphate. Finely ground limestone rock did not affect the teeth adversely.

Many mineral mixtures for which very strong claims are frequently made, most of which cannot be substantiated, are offered for sale. The complex mineral mixture used in this investigation was one of the most widely advertised mineral mixtures for dairy cattle in 1922. None of

the claims of the advertiser were substantiated. This mixture proved not only worthless but was actually harmful to the health of the animals to which it was fed.

Dairy cattle fed plenty of good quality hay, silage, and pasture in season seldom need a mineral supplement supplying calcium. Additional mineral supplements supplying calcium do not prevent milk fever as is frequently stated. Milk fever is thought to be due to low blood calcium which probably is not affected by the level of calcium in the ration. Broken hips cannot be attributed to a lack of calcium in the ration. As a matter of fact, calcium deficiency rarely occurs among dairy cattle under farm conditions.

Conclusions

The results of this investigation show that the need for mineral supplements for dairy cattle fed under normal Michigan conditions has been greatly exaggerated. They especially show that there is little need for mineral supplements which supply calcium even though feeds such as timothy hay and other low calcium roughages are used. This conclusion was shown by growth, milk production, reproduction, and health records over a long period of time and also by metabolism trials at different stages of lactation.

This study further shows that cattle are able to utilize the calcium from their feed more efficiently than was formerly believed.

Raw rock phosphate should not be fed to dairy cattle due to its high fluorine content which produces detrimental effects. Complex mineral mixtures may be harmful when fed a long time.

Limestone rock finely ground had no effects on health, growth, reproduction, or milk production.

Recommendations

When plenty of good quality roughage is fed with protein concentrates, such as linseed oil meal, cottonseed meal, wheat bran, or gluten feed, mineral supplements supplying calcium and phosphorus are not needed in the ration of growing cattle or milk cows under ordinary farm conditions.

Rations consisting of legumes, such as alfalfa and clover, and cereal grains with no protein concentrate may be deficient in phosphorus when fed to milking cows. This deficiency may be met by feeding special steamed bone meal and salt, equal parts. Allow free access to this mixture. This deficiency may also be met by the addition of a protein concentrate, such as cottonseed meal, linseed oil meal, wheat bran, gluten meal, or soy bean meal.

On farms where goiter occurs, add 0.05 pounds of pulverized sodium iodide or potassium iodide to 100 pounds of salt and mix thoroughly.

EARLY PLANTED POTATOES PRODUCE BEST QUALITY

Immature Tubers Disappoint Buyers and Cause Discrimination Against Michigan Stock

H. C MOORE AND J. J. BIRD, SECTION OF FARM CROPS

Ninety per cent or more of Michigan's late potato crop is the Russet Rural, a variety that requires 120 to 130 days to mature. When properly matured, this variety compares favorably with other varieties in market and culinary qualities. Too often, however, a large portion of Michigan's potato crop is green or immature when marketed. The potatoes have dark skins, are easily bruised, and when cooked are usually dark in color, soggy, and of poor flavor. The marketing of immature potatoes seriously handicaps the whole potato industry of Michigan. Markets discriminate against sections shipping immature stock.

Fig. 1.—Date of planting experiment W. K. Kellogg Farm, Augusta, Michigan (1930).

Each pile from 160 ft. row. (Left)—May 15 planting—yield 77.5 bu. per acre. (Center)—June 5 planting—yield 84 bu. per acre. (Right)—June 24 planting—yield 37 bu. per acre.

To obtain data on the value of early planting for improving the market quality of potatoes, "planting date" tests were conducted on 18 farms in 14 Michigan counties in 1930. In these tests, Russet Rurals were planted during the weeks of May 12, May 26, and June 9. The three date-of-planting plots were given the same cultural treatment throughout the season. The plots were harvested during the last week of September and the first week of October.

At harvest time, yield records of total production and of U. S. No. 1 grade potatoes were secured. Notes were also made on the color, type, maturity, and other qualities of potatoes from the three planting date plots. Data obtained on the comparative quality of the different lots showed in practically every case that potatoes harvested from the May 12 and May 25 plots were firmer, brighter in color, and less sub-

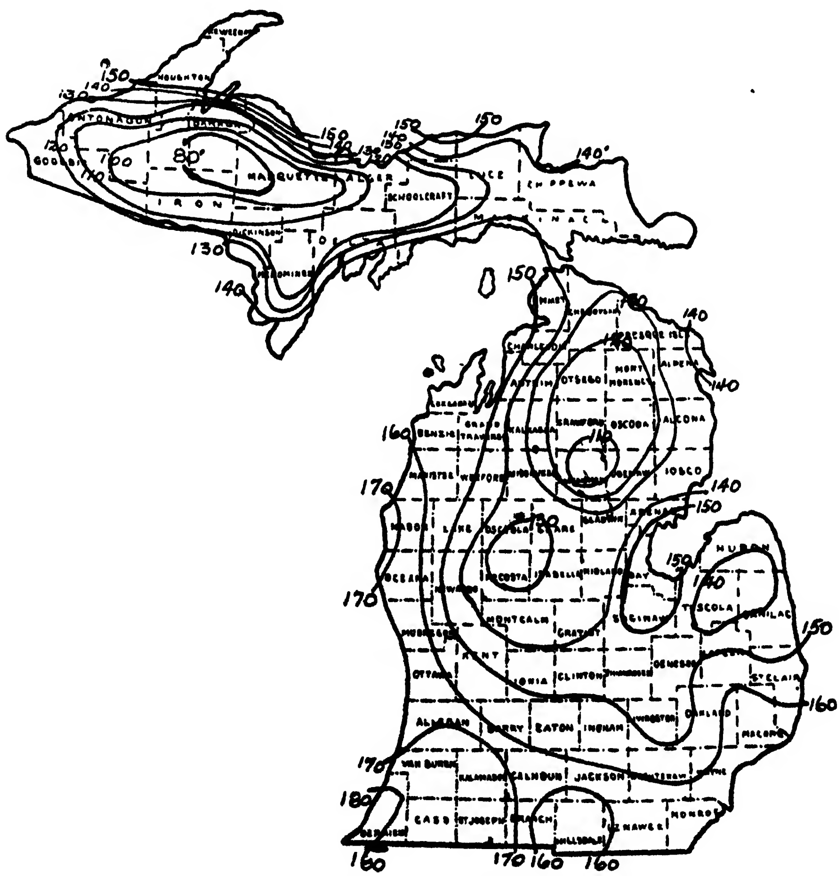

Fig. 2.—Average number of days in growing season (from last killing frost in spring to first killing frost in autumn).

Suggested planting dates for the southern three tiers of counties are June 1 to 10; for counties between those tiers and the northern boundaries of Mason, Clare, Arenac counties, May 20 to 31; all counties north of that line **May 10 to 20.**

ject to mechanical injury than potatoes from the late planted (June 9) plots. No significant differences were noted in the three date-of-planting plots in the percentage of off-type tubers or in the percentage of scab and black scurf injury. Neither did the date of planting have any marked effect on the set of tubers. The average number of tubers per hill for the May 12, May 26 and June 9 plantings were respectively 7.57, 6.73 and 6.32.

Yield records were obtained from all the plots and are listed in Table 1.

Table 1.—"Date of Planting" Tests—Michigan, 1930

Name and Address of Cooperator	Planted week of May 12, 1930		Planted week of May 26, 1930		Planted week of June 9, 1930	
	Total yield per acre Bushels	Yield per acre U. S. No. 1 Bushels	Total yield per acre Bushels	Yield per acre U. S. No. 1 Bushels	Total yield per acre Bushels	Yield per acre U. S. No. 1 Bushels
Reimer Bros. & Hoppe, Hawks, Presque Isle County	294 03	265.72	247 32	214 65	188 28	163 35
N. J. Rasmussen, Petoskey, Emmet County	137 12	116.64	140 36	112.29	148 44	111.32
A. L. Dunlap, Kalkaska, Kalkaska County	116 20	70.70	101 60	62.90	98.20	58.10
C. Carroll, Kalkaska, Kalkaska County	83 70	53 24	86 20	60.50	81 30	46.00
J. Caner, Harrison, Clare County	127.10	90.7	134 9	92.3	114 9	70 8
L. Wilcox, Evart, Osceola County	37 3	14 5	39.7	15 5	32.4	8.2
J. Budzynski, Fountain, Mason County	120 68	82 28	140 36	77 44	122.94	71 63
O. Buschlein, Snover, Sanilac County	145.20	117 37	157.30	136.13	130.08	92 57
John Noon, Jackson, Jackson County	......	......	94.86	48 88	37.27	33 88
J. Overbeck, Hamilton, Allegan County	102 85	79 86	98 49	73 81	59 53	48 40
J. Merril, Grand Junction, Allegan County	102 09	67 79	96 65	68 60	84 94	56.63
W. L. Whitney, Port Sanilac, Sanilac County	71.15	31 46	49 85	16 46	31 94	3 87
John Lucas, Tustin, Osceola County	108 90	61 71	132 13	111 56	99 70	77 29
W. Wiltse & Son, Morley, Mecosta County	109 68	94.81	106 09	92 76	76 36	54 33
John Welti, Temperance, Monroe County	......	......	89.98	64 37	54 45	41 11
Leon Montri, Erie, Monroe County	114 95	94 38	......	......	88 33	71 63
R. Rossman, Greenville, Montcalm County	124 00	100 00	103 00	79 00	98.00	71.00
R. Shumaker, Coldwater, Branch County	......	......	113.74	75 63	117 37	72 00

A summary of Table 1, shows the following average yields for the three dates of planting.

Date of Planting	Average total yield per acre Bushels	Average yield per acre U. S. No. 1 Bushels
May 12, (15 tests)	119.66	89.41
May 26, (17 tests)	113.69	82.52
June 9, (18 tests)	92.47	64.00

In the 1930 tests, the earlier planted plots produced potatoes of the best market quality and of the highest yield per acre. These results were obtained in a year of intensive drought, when many growers reckoned on better yields from late plantings.

The acommpanying map shows the average length of the growing season for various sections of the State. Potato growers should have this information and should not try to grow in 80 or 90 days a variety that requires 120 to 130 days to mature. Too many of the growers are sacrificing quality of product by planting late in order to escape an extra cultivation or spray application. Late planting and late harvesting cause heavy losses to Michigan potato growers. Late planting prevents the potatoes from ripening properly and late harvesting often results in their being frosted in the field. Earlier planting will permit earlier digging and the escaping of much injury from field frost.

Recommended planting dates for the different districts of the state are. indicated on the map.

GOOD SEED POTATOES ARE NOT PLENTIFUL THIS YEAR

Short Crop and Frost Injuries Make It Necessary For Growers to Locate Supply Early

H. C. MOORE, SECTION OF FARM CROPS

A short crop and severe frost injury during 1930 warrant the early attention of many growers to sources of good seed potatoes. Drought and frost not only reduced Michigan's 1930 potato crop to the low record of 15,254,000 bushels but also seriously injured for seed purposes much of the stock now available for planting. The dry weather prevented normal tuber growth in many sections of the State, with the result that a high percentage of potatoes are pointed, knobby, or otherwise of poor type. Severe frosts in October froze many potatoes and a large portion of the frozen potatoes rotted in the ground or in storage soon after they were dug. Much of the stock, however, that was exposed to field frost was only slightly frosted or chilled and may not break down in storage where the temperature is kept at 40° F. or less. When removed from storage, however, and exposed to a temperature of 60° F. or more they may rot or become badly wilted and be unfit for seed.

Growers having potatoes that were exposed to field frost should take every precaution to eliminate chilled and frosted potatoes from their seed stock. The extent of the field frost injury should be determined during the winter or early spring so that, if the frost damage is serious, arrangements can be made to purchase good seed that is frost free.

These suggestions are given for checking up on frost injury:

(1) Cut 100 potatoes selected from different sections of the pile. Make a count of those that show discoloration in the flesh. Usually a slightly chilled potato will show faint bluish gray blotches in the flesh especially near the stem end. Potatoes more severely chilled may show black blothes or dark brown specks throughout the flesh. The only potatoes that will be safe to plant are those having a clean white flesh.

(2) Take a bushel or more of potatoes out of storage and spread them out on a table in the dwelling house where they will be exposed to light and where the temperature is about 70° F. When exposed to this temperature the frosted tubers will generally decay or become soft and flabby in a few days. Those tubers that remain firm may be satisfactory for seed provided they develop stocky green sprouts when kept at the 70° temperature for two or three weeks. Potatoes that grow thin, weak sprouts or that do not sprout at all will be worthless for seed. A strong stubby development of sprouts at the seed end of the tuber is usually a good indication that the potato has good seed vigor.

Sources of Good Seed

Many growers after they have examined and tested their potatoes may find it necessary to procure new seed. There is considerable good seed available in Michigan, the supply is not so great, however, that its purchase can be delayed until the time of planting. Much of the good stock is being bought by potato growers in other states and some of it will go on the table stock market during the early spring.

The best seed available is certified seed. Michigan produced only 189,000 bushels of certified seed in 1930 compared to 437,000 bushels in 1929. A large portion of the 1930 certified seed crop has been sold or contracted for sale; there is still available, however, at this date (January 20) approximately 50,000 bushels of certified seed mostly of the Russet Rural variety. Certified seed of White Rural, Green Mountain, and Irish Cobbler varieties is limited. In addition to the certified seed, there are many lots of good potatoes that were produced in 1930 from certified seed, but which were not inspected or certified. The fields, however, were kept well sprayed during the summer and the potatoes were harvested before severe frosts. When carefully graded, such potatoes should prove satisfactory for table stock production.

The Michigan State College in co-operation with county agricultural agents has made a seed potato survey for the purpose of locating sources of good seed. Growers wishing to procure seed potatoes can get information on seed stocks from their county agricultural agents or from the farm crops department of Michigan State College.

SPRAYER ACCESSORIES AFFECT EFFICIENCY OF EQUIPMENT*

Size and Character of Fittings Influence the Pressure and Quantity of Sprays Applications

GLENN R. STARCHER, SECTION OF HORTICULTURE

Fruit growers have long been interested in the control of insects and diseases and much attention has been given to the materials used for pest control. The sprayer and its accessories always have been conspicuous in control operations but too little attention has been given to the factors that affect its operating efficiency. It is the purpose of this report to present the results of studies to determine the relation to pressure loss and to delivery from the nozzle of variations commonly found in several of the accessories necessary in spraying operations. Included in these are hose, hose fittings, cut-offs, rod parts, and gun and nozzle discs.

Method of Procedure

All tests were made on a sprayer equipped with a three cylinder pump with a rated capacity of 16 gallons per minute. The pump was operated with a five horsepower electric motor which was substituted for the usual gasoline engine. Tap water was used for all tests. A standard, single nozzle spray gun was used in most of the work, though for certain of the studies multiple nozzle rods were substituted. Pressure gauges of the type usually furnished on sprayers were used and were calibrated from 0 to 600 pounds in units of 10 pounds. One gauge was kept as a standard for checking all others in use. Because of the slight variation that sometimes occurred between gauges, the oscillation of the indicator hand, and the large interval between calibrations, it was impossible to make readings closer than five pounds, and there are occasional indications of more error than that.

The water for each run was delivered into a 60 gallon tank which was placed on platform scales. Two readings for each run were made and unless the delivery checked within 0.25 pound the runs were repeated.

The diameters of disc apertures are referred to as whole numbers, one sixty-fourth of an inch being the standard. Thus a disc with a 4/64 (1/16) inch opening is referred to as a "number four" and a disc with an opening 12/64 (3/16) inch in diameter is called a "number twelve."

*The material here presented was condensed from a thesis presented to the Faculty of Michigan State College in partial fulfillment of the requirements for the M. S. degree.

Some of the data are incomplete at high pressures and for large disc apertures because the expected delivery would be in excess of the capacity of the pump or because the air chamber pressure would have to be higher than 450 pounds which was the maximum used.

Presentation of Results

The detailed data are presented in the accompanying tables. A discussion of the relation of each factor to pressure loss and delivery is taken up in the following paragraphs.

Disc Aperture—With equal pressures at the gun, increasing the disc aperture gives an almost equally uniform increase in delivery at each pressure. The increases are greater at high than at low pressures. The increase, however, is less than the proportional increase in the area of the aperture. Doubling the diameter slightly more than doubles the delivery and as the aperture is gradually increased there is a slightly more rapid increase in delivery. The deliveries for each disc with uniform pressures at the gun are shown in Table 1. These data are from tests made with ¾ inch hose. The results with ⅜ and ½ inch hose are almost identical so long as uniform pressures are maintained at the gun.

Table 1.—Delivery from several discs at various pressures.

Disc Aperture	Delivery (gallons per minute) with pressures at the gun of					
	150 lbs.	200 lbs.	250 lbs.	300 lbs.	350 lbs.	400 lbs.
4	93	1 11	1 26	1 38	1.48	1.59
6	1 92	2 31	2.59	2 83	3 07	3.29
7	2 69	3 15	3 51	3 86	4 19	4.50
8	3 47	4 09	4 64	5 08	5 52	5.94
9	4 46	5 24	5 93	6 53	7 10	7.62
10	5.63	6 69	7 45	8 22	8 91	9.56
12	8 23	9 52	10 78	11 83	12 89	13.74
14	10.62	12 47	13 92	15 48		
16	13.77					

Pressure—Uniform changes in pressure gave equally uniform changes in delivery. Increasing the pressure at the gun from 200 to 400 pounds with disc apertures of 4, 6, 7, 8, 9, 10, and 12 increased the deliveries 43, 42, 43, 45, 45, 43, and 44 per cent, respectively. The differences fall within the range of experimental error. When compared on the basis of pressures at the pump, the percentage of increase is lower and more variable because of pressure losses between the pump and the nozzle. **The delivery depends only in part upon the pressure at the pump—it is the pressure at the gun that is most important.** The actual deliveries for each disc aperture at the several pressures are shown in Table 1.

Diameter of Hose—The delivery and pressure at the gun with hose of small diameter, when the disc aperture and pressure at the pump are uniform, may be much less than with hose of large diameter. The amount of pressure that can be lost without seriously affecting nozzle efficiency has not been established in these tests; but, if it is assumed that any loss in pressure greater than 30 pounds is serious, it may be

Table 2.—The Relation of the Diameter of the Hose (with ordinary fittings) to Pressure Loss and Delivery.

Hose	Pressure at pump	Pressure lost in hose and fittings and delivery with disc apertures of																	
		4		6		7		8		9		10		12		14		16	
		Pressure loss	Delivery	Pressure loss	Delivery	Pressure loss	Delivery	Pressure loss	Delivery	Pressure loss	Delivery	Pressure loss	Delivery	Pressure loss	Delivery	Pressure loss	Delivery	Pressure loss	Delivery
50 feet, ⅜ inch	200	...	1.11	5	2.29	15	3 02	30	2 83	50	4 48	60	5 45	100	6 53	125	7 45	145	8 06
	250	...	1.26	10	2 54	25	3 41	35	4 27	65	4 94	75	6 13	120	7 45	155	8 29	180	9.10
	300	...	1.39	10	2 78	30	3 74	40	4 69	80	5 54	95	6 72	145	8.28	185	9 30	215	10.21
	350	...	1.47	10	3.02	30	4 06	55	5 07	85	6 11	110	7 28	170	8 89	215	10 14	250	11.05
	400	...	1.59	20	3 21	35	4 33	55	5 43	100	6 53	130	7.81	195	9 71	245	10 87	290	11.85
	450	...	1.68	25	3 40	45	4 55	70	5 73	120	6.89	140	8 35	215	10 36	275	11 65	325	12 58
50 feet ½ inch	200	...	1.11	...	2.31	5	3 14	10	4 00	15	4 94	25	6 15	50	8 23	60	10 25	95	11.50
	250	...	1.26	...	2 58	5	3 49	10	4 46	20	5 60	35	6 89	60	9 27	80	11.50	115	13.07
	300	...	1.38	...	2 84	5	3 85	10	5.00	25	6 23	40	7 66	70	10 19	100	12 59	140	14.40
	350	...	1.47	...	3 06	5	4 18	15	5 33	30	6 75	45	8 28	80	11 24	110	13 59	165	15 73
	400	...	1.59	...	3 29	10	4 48	20	5 69	35	7 25	50	8 90	90	12 04	130	14 49	...	...
	450	...	1.68	...	3 48	10	4 70	20	6 12	40	7 68	55	9 45	110	12 69	155	15 33	...	...
50 feet ¾ inch	200	...	1.11	...	1 92		3 15	5	4 03	5	5 18	10	6 54	15	9 13	25	11 65	45	14 50
	250	...	1 26	...	2 51		3 51	5	4 56	5	5 84	10	7 33	15	10 38	35	12 93	55	16.02
	300		1 38	...	2 59		3 86	5	4 99	10	6 44	15	8 02	25	11 47	40	14 23	...	...
	350	...	1.48	...	2 83		4 19	10	5 43	10	6 96	15	8 69	25	12 40	50	15 48		...
	400	...	1.59	...	3 07	5	4 48	15	5 80	15	7 47	20	9 33	30	13 23		...		...
	450		1 68	...	3 29	5	4 76	15	6 20	20	7 90	20	9 96	35	14 11	...			...

stated that, with ordinary fittings, 50 feet of ⅜ inch hose is efficient with deliveries up to about four gallons per minute; that 50 feet of ½ inch hose is efficient with deliveries up to about 6.75 gallons; and 50 feet of ¾ inch hose is efficient up to about 14 gallons per minute.

The relation of the hose, with ordinary fittings, to the pressure at the gun is clearly shown by the fact that with 400 pounds pressure at the pump and a number 10 disc there was a decrease in pressure at the gun of 130 pounds with ⅜ inch hose, 50 pounds with ½ inch hose, and only 20 pounds with ¾ inch hose. These pressure losses affect delivery as indicated in Table 1 and as discussed in the preceding paragraph. A tabular statement of pressure losses and deliveries for each hose with several pressures and disc apertures is presented in Table 2. These figures cannot be considered as being correct for every set-up as hose and fittings vary considerably. It is important that the discussion presented in this paragraph should be considered carefully in connection with the discussion of hose fittings in the next paragraph.

Hose Fittings—The substitution of hose fittings with large openings for the so-called "ordinary fittings" with small openings makes a marked difference in pressure loss and, consequently, in delivery with ⅜ and ½ inch hose but less difference is noticeable with ¾ inch hose with deliveries up to 16 gallons per minute. Similar differences would undoubtedly be found with the ¾ inch hose with larger delivery.

Table 3.—Measurements of Ordinary and Large Hose Fittings.

To Fit Hose	Ordinary Fittings				Large Fittings			
	Female		Male		Female		Male	
	Pipe End	Hose End	Pipe End	Hose End	Pipe End	Hose End	Pipe End	Hose End
⅜ inch	.250 inch	230 inch	.226 inch	.203 inch	.328 inch	.297 inch.	320 inch	.289 inch
½ inch	363 inch	324 inch	305 inch	367 inch	.406 inch	.406 inch	406 inch	406 inch
¾ inch	.438 inch	391 inch	375 inch	398 inch	.664 inch	648 inch	672 inch	.652 inch

The diameters of the openings are shown in Table 3 and the comparative effect of these two types of fittings on pressure loss is shown in Table 4. These figures show, for equal pressures, that ⅜ inch hose with large fittings is as efficient as ½ inch hose with ordinary fittings and that ½ inch hose with large fittings approaches ¾ inch hose in efficiency. No significant differences are shown between the two types of fittings on ¾ inch hose, but differences undoubtedly would show with delivery increased beyond 16 gallons per minute, the capacity of the pump used in these tests. It is evident, therefore, that it is possible to substitute the lighter and less expensive hose, under certain conditions, for the larger and heavier hose, provided fittings with large openings are used.

Length of Hose—Under the conditions of these experiments, it was found that the length of the hose, up to 50 feet, was not so significant in reducing pressure as the type of fittings used. A comparison of 50 and 12½ feet of ⅜ inch hose shows that the reduction of 75 per cent in length reduced the pressure loss about 25 to 30 per cent with both ordinary and large fittings.

Table 4.—The Relation of Hose Fittings to Pressure Losses.

Hose	Pressure at pump	Pressure losses with ordinary and large hose fittings with disc apertures of																	
		4		6		7		8		9		10		12		14		16	
		Ordinary	Large	Ordinary	Large	Ordinary	Large	Ordinary	Large	Ordinary	Large	Ordinary	Large	Ordinary	Large	Ordinary	Large	Ordinary	Large
50 feet 3/8 inch	250	....	.. .	10	.	25	. . .	35	5	65	15	75	30	120	65	155	95	180	130
	350	. .....	....	10	..	30	10	55	20	85	30	110	50	170	90	215	135	250	175
	450	. ....	.. ....	25	10	45	20	70	30	120	40	140	65	215	115	275	175	325	.
50 feet ½ inch	250	..				5		10		20	5	35	10	60	30	80	50	115	70
	350		.	.		5		15		30	5	45	20	80	45	110	65	165	.
	450	.				10		20		40	5	55	30	110	50	155			....
50 feet ¾ inch	250	. . .			.			5	5	5	5	10	10	15	15	35	35	55	55
	350	. . .		..				10	10	10	10	15	15	25	25	50	50		.
	450	. .	. .			5	5	15	15	20	20	20	25	35	35				..

Multiple Nozzle Rods

The use of multiple nozzle rods is increasing and in this connection certain facts are presented.

Number of Nozzles—A rod with four nozzles, for instance, will not deliver quite four times as much liquid as a single nozzle gun with a disc with same aperture as those used in the rod. There is more friction in the rod than in the gun because a rod which delivers the same volume of spray as a gun requires greater pressure.

Diameter of Tubing in Rod—It was found that the pipe or tube making up the body of the rod was large enough in the three rods tested to carry the amount of liquid that each rod was designed to deliver.

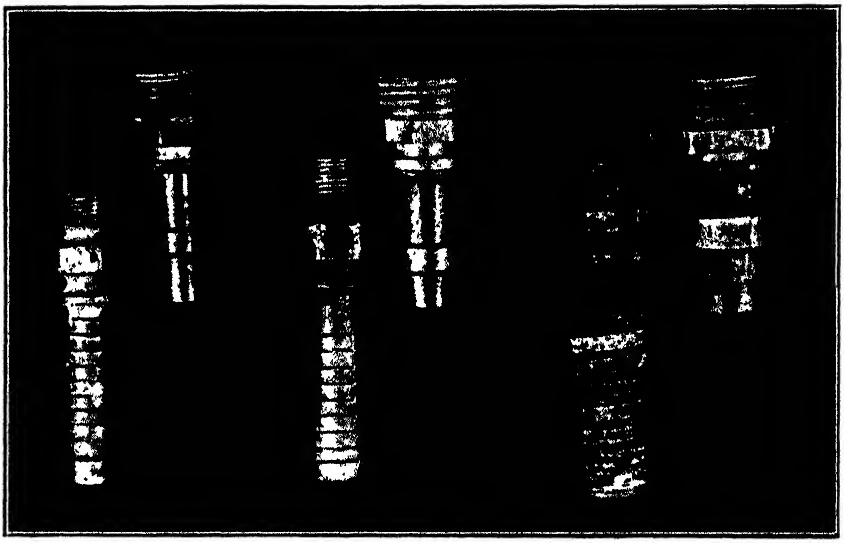

Fig. 1.—Hose fittings. Left to right—⅜ inch, ordinary and large; ½ inch, ordinary and large; and ¾ inch, ordinary and large.

Rod Cut-offs—Cut-offs vary in construction and the larger ones offer less resistance than the small ones, but here, as with the tubing, all cut-offs were efficient so long as used on the types of rods for which they were intended. In other words, a small cut-off is satisfactory on a rod with three or four nozzles but larger cut-offs are desirable for six and eight nozzle rods.

Nozzle Whirl-Plates—The number of holes in the nozzle whirl-plates affects the delivery from the nozzle. A plate with four holes offers greater resistance than one with six holes and the number of holes has a marked effect on the pattern of the spray. A more spreading type of spray, which will travel a shorter distance is formed with the four-hole whirl-plates.

CAUSES OF MORTALITY IN LAYING HENS

Eight Year Mortality Records at Michigan International Egg Laying Contest Show Most Prevalent Poultry Diseases

H. J. STAFSETH, SECTION OF BACTERIOLOGY
E. S. WEISNER, SECTION OF POULTRY HUSBANDRY

Since the beginning of the Contest at this station on November 1, 1922, complete records have been kept on the death of each individual entered in the competition. The diseases and causes contributing to or causing death have been determined by autopsy and by culturing of various organs. From these records, it has been possible to compile the number of deaths for each breed and variety, causes of death of each individual, and the number of deaths each months for the eight year period ending September 23, 1930. All hens that have died during this period have been autopsied at the department of bacteriology of this Station.

Highly contagious diseases have been responsible for a large number of the deaths shown in the following tables. These diseases have caused some variation from the normal death rate during some months of the eight years tabulated.

Table No. 1 shows the number of birds that have died each year of the contest and the diseases or contributing causes in each case. As the autopsy report of an individual may show as many as three or four maladies contributing to death, no attempt has been made to list the exact cause. The total number of all diseases and causes of death total 2,176 for the 1,898 deaths.

It may be noted that diseases of poultry are increasing. The fourth, fifth and sixth years of the contest shows an increase over the first three years in number of deaths. The seventh and eighth years show an increase in the number of contributing causes over the previous six years. The year 1927-28 shows the highest mortality of all yearly periods. The heavy mortality during that year was caused by laryngotrachitis, commonly known as infectious bronchitis, which broke out in epidemic early in the winter. This disease alone accounted for over 20 per cent of the mortality of that year. During the year 1929-30 bronchitis accounted for more than 25 per cent of the year's mortality. Bronchitis of the highly infectious types, as during these two years, is very fatal and adequate means of control have been lacking.

From the figures shown, it is evident that some diseases have become more prevalent during the eight year period, while others have shown a decided decrease. Diseases and causes which are apparently on the increase are peritonitis, sarcamatosis, bronchitis, pericarditis, tumors, leucosis, and diseases attacking the organs of egg production, such as

Table 1.—Diseases Found on Autopsy During Eight Year Period.

Name of Disease or Condition Causing Death	1922 1923	1923 1924	1924 1925	1925 1926	1926 1927	1927 1928	1928 1929	1929 1930	Total Cases of each Disease
Peritonitis	10	14	18	28	14	17	22	11	134
Sarcamatosis	7	9	10	16	20	28	45	14	149
Internal Hemorrhages	10	16	13	10	16	18	1	3	87
*Fowl Cholera	32	25	9	12					78
Fowl Pox	10	16	9	11	12	17	5	1	81
Round Worms	9	9	10	15	9	14	9	5	80
**Laryngo-trachitis				2	9	54	21	67	153
*Enteritis	15	10	10	6	8	15	8	7	79
Visceral gout	12	6	5	10	14	12	5	1	65
Egg Material in Abdomen	5	3	10	8	12	21	18	34	111
Roup	5	10	15	4	1	20	2	7	64
Ruptured Oviduct	6	10	6	11	9	10	6	15	73
Fatty Degeneration of Liver	9	11	7	8	6	10	7	4	62
Impaction of Crop	7	5	7	11	5	10	10	4	59
*Pericarditis	0	4	6	3	12	19	8	3	55
*Diseased Liver	6	8	4	4	7	8	1		38
Tumor		2	6	4	5	16	2	2	37
Leucosis	5				16	9	12	23	65
Tuberculosis	11	2	8		7	1		2	31
Fowl Typhoid	10	8		4	3	3	1		29
Bacillary White Diarrhoea	7	9	5	3	2		3		29
*Necrosis of Liver		2	4	1	7	11			25
Tape Worms	3	4	2	2	8	6	6	5	36
Leg Weakness	10	8	5				1	1	25
Prolapse of Oviduct	4	2	2	1	5	6	4	7	31
Abscess		2	4	1	2	4		1	14
Cyst of Oviduct	3	2	3		2	3	3	1	17
Killed for cause	2	3	6		2				13
Coccidiosis					5	6	1	3	15
Ruptured Liver	5		3	2	1		2		13
Salpingitis					4	7	1	7	19
Cannibalism	1	3	4		1	1	8	12	30
*Nephritis	1	1		2	2	4	4	1	15
Ruptured Intestines	2	4	1		1	1			9
Anaemia			1		1	5	1		8
Hematoma			1	1	1	3	4		10
Stolen or unaccounted for	5	1							6
Edema of Wattles		1			2	2		2	7
Pneumonia	3	1	1				3	1	9
Accidental	1	2			1		1		5
Colibacillosis	3					1		1	5
Fibrous Material in Gizzard	1		1			2			4
Heat Prostration			2		1			3	6
Prolapse of Instestines	1		1			1			3
Vent Gleet			1	1		1			3
Ititis				1		1			2
Hemorrhage of Comb	2								2
Punctured Proventriculus						2			2
Thrombosis						2			2
Aspergillosis	1								1
Empyema (Pleural)	1								1
Cyst on Liver						1		1	2
Injury from fighting			1					2	3
Bumblefoot					1				1
Entero-Hepatitis		1					1		2
Intussception						1			1
Ruptured Gizzard	1								1
Septicemia						1			1
Toxemia					1				1
Undiagnosed	24	19	18	16	11	6	7	17	118
Undetermined	22	16	15	11	6	7	19	13	100
Adenosarcoma							3		3
Paralysis							2	1	3
Impaction of Intestine							5		5
Ruptured Yolk							3		3
Obesity							2		2
Dropsy							3	1	4
Obstruction of Oviduct							3	12	15
Neuro-Lymphomatosis							1		1
Grangrene of Vent								1	1
Necrotic Pharangitis								1	1
Infection of Air Sacs								1	1
Ascites								1	1
Total Causes and Diseases	272	249	234	207	252	386	283	291	2,176
Total Deaths	251	244	213	203	220	314	221	229	1.898

*An attempt is made to identify as nearly as possible the cause of each disease and to name it accordingly as, e.g., bacillary white diarrhoea, fowl cholera, sarcamatosis, etc. However, in many cases where enteritis and abnormalities of the liver, pericarditis, nephritis, and other diseases were found the cause could not be ascertained.

**Commonly known as Infectious Bronchitis.

Table 2.—Summary of Diseases Found on Autopsy by Breeds for Eight Year Period.

Name of Disease or Condition Causing Death	Barred Rocks	White Rocks	Columbian Rocks	Buff Rocks	Rhode Island Reds	White Wyandottes	Buff Wyandottes	Black Orpingtons	Black Minorcas	Brown Leghorns	Buff Leghorns	Anconas	Dominiques	Barnvelders	White Leghorns	Total Cases of each Disease
Peritonitis	17	2		1	11	4	1			4	1	5			88	134
Sarcamatosis	31	5		1	15	3	2			4		2			86	149
Internal Hemorrhages	25	2		4	6	1				2		9			38	87
Fowl Cholera	16	1		2	6	5	2	1		2		8	1		34	78
Fowl Pox	13	5			4	9						3			47	81
Round Worms	9	1			3							6			61	80
Laryngo Trachitis	44	2			35	4				1		3			64	153
Enteritis	11				7	5	1			3	2	2			48	79
Visceral Gout	14			1	11	5				1		2			31	65
Egg Material in Abdomen	12	4			8						2	2			83	111
Roup	15				2	1	1			1	1	5			38	64
Ruptured Oviduct	11	2			5	5				2	1	7	1		39	73
Fatty Degeneration of Liver	20	2		1	4	1						2			32	62
Impaction of Crop	10	3			6	1						2			37	59
Pericarditis	11	1		1	4	1						1			36	55
Diseased Liver	7	1			8										22	38
Tumor	7	1		1	7	1				1					19	37
Leucosis	21	6			7							1			30	65
Tuberculosis	6			1	14										10	31
Fowl Typhoid	7				1	2				1		6			12	29
Bacillary White Diarrhea	10	1			2	1	1					1			13	29
Necrosis of Liver	6			1	3	1				1					13	25
Tape Worms	7	1			1										27	36
Leg Weakness	12	1		1	1	1		1							8	25
Prolapse of Oviduct	6				2					1		1			21	31
Abscess	4				3										7	14
Cyst of Oviduct	7	1			2						1				6	17
Killed for Cause	3				1										9	13
Coccidiosis	2				3							1			9	15
Ruptured Liver	4				3					1					5	13
Salpingitis					2	1									16	19
Cannibalism				1	3	1		1				2			22	30
Nephritis	1				2										12	15
Ruptured Intestines												2			7	9
Anaemia												1			7	8
Hematoma	1				3										6	10
Stolen or Unaccounted for															6	6
Edema	2														5	7
Pneumonia	2	1				1									5	9
Accidental	2														3	5
Colibacillosis	1				1				1						2	5
Fibrous Material in Gizzard	2														2	4
Heat Prostration		1													5	6
Prolapse of intestines											1				2	3
Vent Gleet	1														2	3
Iritis	1														1	2
Hemorrhage of Comb															2	2
Punctured Proventriculus	1														1	2
Thrombosis	1														1	2
Aspergillosis															1	1
Empyema (Pleural)															1	1
Cyst on Liver											1				1	2
Injury from Fighting															3	3
Bumblefoot															1	1
Hepatitis															2	2
Intussoeption															1	1
Ruptured Gizzard															1	1
Septicemia					1											1
Toxemia					1											1
Undiagnosed	17	1			14	6	2	1	4	1		5			67	118
Undetermined	18	3		1	13	4				1		7			62	109
Adenosarcoma	2	1														3
Paralysis	2														1	3
Impaction of Intestine	2														3	5
Ruptured Yolk	1														2	3
Obesity	1	1														2
Dropsy	1	1													2	4
Obstruction of Oviduct	2	1			1										10	15
Neuro-Lymphomatosis															1	1
Gangrene of Vent	1															1
Necrotic Pharangitis					1											1
Infection of Air Sacs															1	1
Ascites	1															1
Total Diseases	431	52	...	17	226	65	10	4	5	27	10	86	2	.	1240	2176

ruptured oviduct with egg material being found in the abdominal cavity, obstruction of the oviduct, and salpingitis. Those showing a decided decrease are fowl cholera, tuberculosis, fowl typhoid and leg weakness. Some of these are rarely found in contest hens.

Table No. 2 shows the number of deaths of each breed and variety for the various diseases and causes over the eight-year period.

Table No. 3 shows the total number of hens of each breed and variety entered, total deaths, and per cent mortality for the eight contests.

Table 3.—Total Birds entered in Contest by Breeds and Varieties during the Eight Year Period.

Breeds and Varieties	1922 1923	1923 1924	1924 1925	1925 1926	1926 1927	1927 1928	1928 1929	1929 1930	Total birds of each breed entered	Total deaths each breed and variety	Per cent mortality each breed and variety
Barred Rocks	216	252	204	204	195	195	260	260	1,786	371	20 5
White Rocks	12	12	12		13		39	39	127	40	31 4
Buff Rocks	12	12		12					36	17	47 2
Columbian Rocks				12					12		
Dominique		12							12	2	16 6
White Wyandottes	108	60	36		13			26	243	04	26 3
Buff Wyandottes	12	12		12					36	9	25 0
S. C. Rhode Island Reds	60	84	120	144	234	156	91	78	967	205	17 3
R. C. Rhode Island Reds	12	12	12	12	13	39	26	26	152		
Black Orpingtons	12								12	3	25 0
Barnvelders				12					12		
Black Minorcas	12	12							24	5	20 8
Anconas	84	84	36	36	39	26			305	83	27 2
R. C. Brown Leghorns		12							12	27	21 7
S. C. Brown Leghorns	24	12	12	12	13	13	13	13	112		
Buff Leghorns	12		12	12		26	13		75	7	9 3
White Leghorns	624	624	756	732	780	845	858	858	6,077	1,065	17 5
Totals	1,200	1,200	1,200	1,200	1,300	1,300	1,300	1,300	10,000	1,808	18 98

Table No. 4 shows the number of deaths each month during the eight years. It is interesting to notice that the months March, April, and May furnish the highest mortality. It is during these three months that egg production is heaviest and it is apparent that intensive production lowers the disease resisting power of the hen as well as providing conditions favorable for the various causes affecting the reproductive system.

November, the first month of the contest, previous to the present one, shows the lowest death rate, contributing much less than 1 per cent of the year's total mortality. December and January show a marked increase over November, due to the appearance of more contagious diseases; July stands out as a month of high death rate. This may be explained as in part due to the first real hot weather month in this State. Many hens completing an intensive winter and spring production have some developing organic trouble and are unable to withstand the condition which causes death.

The total percentage mortality of 18.98 for the eight year period is very significant. This indicates that nearly one-fifth of the pullets die during their first year of egg production. The 10,000 birds included in this survey represent several hundred different farms and the per

Table 4.—Final Summary Shows the Mortality for the Various Months of the year during the Eight Year Period.

Months	1922 1923	1923 1924	1924 1925	1925 1926	1926 1927	1927 1928	1928 1929	1929 1930	Total deaths by months	Per cent mortality each month
November	4	7	5	9	11	11	11	4	62	.62
December	8	12	21	13	10	37	21	15	137	1 37
January	10	21	19	7	11	35	18	15	136	1 36
February	19	13	12	11	13	24	20	15	127	1 27
March	30	22	*49	25	17	27	21	30	221	2 21
April	38	37	19	19	35	26	32	29	235	2 35
May	35	32	12	22	32	27	27	29	216	2.16
June	29	27	19	16	13	23	14	25	166	1 66
July	34	33	12	27	22	33	20	27	208	2.08
August	11	18	14	14	14	21	11	21	124	1 24
September	14	10	15	10	31	25	20	18	143	1.43
October	15	12	11	22	8	24	8	. .	100	1.00
Date unknown	4		5	8	3	1	1	1	23	.23
Total	251	244	213	203	220	314	224	229	1,898	18 98

*Seventeen birds disqualified, killed and autopsied to determine cause of non-production after being in contest four months

cent mortality of 18.98 is probably close to the average death rate in pullets of Michigan flocks over a period of years.

BULLETIN REVIEWS AND JOURNAL ARTICLE ABSTRACTS

Beginning with this issue of the Quarterly Bulletin, each number will carry brief reviews of new bulletins that have appeared in print within the past three months and abstracts of articles written by Station staff members that have appeared in scientific journals and that report on their experimental work. Copies of the bulletins may be procured by writing to the Michigan Agricultural Experiment Station, East Lansing, Michigan. The Station does not have copies of the journal articles for distribution.

BULLETIN REVIEWS

Circ. Bul. 53 (Revised): FERTILIZER RECOMMENDATIONS FOR 1931.—Millar, C. E., Grantham, G. M. and Harmer, P. M.—This bulletin discusses briefly the points to be considered in selecting the fertilizer to use for different crops when grown on different soil types and in different farming systems. The effects of the plant food elements on growth, maturity, yield, and quality of crops are described briefly and illustrated by photographs. The question of placement of fertilizer in reference to the seed is considered, especially in reference to crops grown on muck soils. Tables show plainly the analyses of fertilizers and the rates of application recommended for various crops under different soil and farming conditions.

Sp. Bul. 204.—INVESTIGATIONS OF CORN BORER CONTROL AT MONROE, MICHIGAN.—Marston, A. R., and Dibble, C. B.—This bulletin describes experiments as conducted at the Monroe Corn Borer Sub-station from 1926 to 1929, inclusive. It reports work conducted to study corn growing and borer control practices under corn borer conditions. These studies include: corn cultural practices, corn breeding for borer resistance, corn borer seasonal history, corn borer infestation and survival on corn and other plants. (47 pages, 18 figures, 32 tables.)

Sp. Bul. 205.—SOIL FERTILIZATION FOR SUGAR BEETS.—Tyson, James, and McCool, M. M.—Field tests with Chilean nitrate of soda, superphosphate, and potash on sugar beets on the main sugar beet producing soils in Michigan show that the best fertilizer ratios for this crop are 1-4-1 and 1-4-2, applied in amounts equal to from 400-600 pounds per acre of 4-16-4 or 4-16-8 fertilizer. Nitrate of soda applied before seeding was just as effective as when the same amount was applied in installments. The residual fertilizer which is left in the soil and in the crop residue greatly increased the yield of the following crop of oats on the fields tested. (31 pages, 9 figures, 26 tables.)

Tech. Bul. 107.—THE LANSING FOOD SURVEY.—Scholl, C. A. and Hedrick, W. O.—This study seeks to measure the food demand of the Lansing Market and the capacity of the eight surrounding townships to meet these demands. It discusses the sources of supplies, the channels of distribution, and the contribution of the surrounding farms. Consumptive demand and productive capacities are discussed under the various headings of Agricultural Resources, Dairying, Fruits and Vegetables, Livestock and Meats, Eggs, Cash Crops, and Lansing—the Market. Considerable attention is paid to land classification and utilization, high production costs imposed on land near industrial centers that force it into intensive production, price making factors, and farm incomes derived from the various enterprises. Throughout, the bulletin presents the advantage of developing the local market by the surrounding farmers, and presents specific recommendations by which nearby farmers may capitalize their proximity to the Lansing and Detroit markets. (152 pages, 21 charts, and numerous tables.)

Tech. Bul. 108.—INFLUENCE OF SOIL CONDITIONS, FERTILIZER TREATMENTS, AND LIGHT INTENSITY ON THE GROWTH, CHEMICAL COMPOSITION, AND ENZYMIC ACTIVITIES OF SUGAR BEETS.—Tyson, James.—Experiments reported in this bulletin show that the chemical composition of beet leaves and roots varies with the soil, fertilizer treatment, light intensity, and time of the year, although there appeared to be no correlation between these and sugar percentages. The growth of beets was greatly influenced by soil conditions and fertilizer treatments, the largest beets being produced where the mineral nutrients were absorbed in the following ratios, in leaves K, P, N, Ca, Mg and in roots K, P, N, Mg, Ca. There was a period of rapid absorption in the early stages of growth, followed by a period of more rapid assimilation than absorption, followed by a period of greater absorption than assimilation. Leaf elongation was indirectly proportional to light intensity to a certain point and total growth was proportional to light intensity. Catalase activity

increased with vigor of growth and oxidase acitivity increased wherever growth was inhibited. (44 pages, 4 figures, 16 tables.)

ABSTRACTS OF JOURNAL ARTICLES

THE CALCIUM AND PHOSPHORUS METABOLISM OF HEAVY MILKING COWS.—Huffman, C. F., Robinson, C. S., and Winter, O. B. —Jour. Dairy Science. 13 (6):432-438, 1930. (Journal Article No. 20 (n. s.) from the Mich. Agr. Exp. Sta.) A series of calcium and phosphorus balances on cows used in the long time mineral feeding investigations reported in Tech. Bul. 105 and Cir. Bul. 129, when in heavy milk production, in medium production, in low milk production, and when dry were determined. The results indicate that a ration of timothy hay, corn silage, and grain supplied sufficient calcium and phosphorus for the production of at least 10,000 pounds of milk a year. During heavy production, cows on this ration were usually losing calcium from their skeleton but during medium production and when dry they stored a sufficient amount of this mineral element to make up for previous losses. Positive calcium and phosphorus balances were obtained in heavy milking cows when the above ration was supplemented with bone flour. A cow producing 80 pounds of milk a day showed positive calcium and phosphorus balances. Also, heavy milking cows stored calcium on a ration of alfalfa hay, corn silage, and grain.

Cows fed rations low in calcium and phosphorus utilized these elements more efficiently than when the rations were high in calcium and phosphorus.

SIGNIFICANCE OF COLON-AEROGENES GROUP IN ICE CREAM. I. SURVIVAL OF MEMBERS OF THE ESCHERICHIA-AEROBACTER GROUP TO PASTEURIZING TEMPERATURES IN ICE CREAM.—Fabian, F. W., and Coulter, E. W.—Jour. Dairy Science. —13: 273-287. 1930. (Journal Article No. 28 (n. s.) from the Mich. Agr. Exp. Sta.)—Thermal death point determinations in ice cream of thirty-three cultures of *Escherichia coli*, seven cultures of *Aerobacter aerogenes*, and four lactose-fermenting organisms from water showed considerable variation when heated in ice cream at temperatures of 60° C. (140° F.), 62.8° C. (145° F.), 65.5° C. (150° F.), and 68.3° C. (155° F.). The determinations were repeated four times with the same cultures, and the number surviving each time varied considerably. The data indicated that the critical temperature for the Escherichia-Aerogenes group in ice cream is about 65.5° C.

Comparative tests with skim milk and ice cream indicated that the latter had a greater protective action. Thermal death point determinations made with the different ingredients used in making ice cream, viz., cream, sucrose, milk powder, and gelatin, failed to show any marked protective action. It was shown that age is an important factor in the susceptibility of bacterial cells to heat. Young cells are more readily killed than the older ones.

It is pointed out that the ability of many strains of the Escherichia-Aerogenes group to survive a temperature of 62.8° C. in ice cream

should be taken into consideration when using this group as a test or index of pasteurizing efficiency. It is suggested that a pasteurizing temperature of 65.5° C. is more desirable than 62.8° C. which is more commonly used.

THE SUSCEPTIBILITY OF THE TURKEY, PIGEON, PHEASANT, DUCK, AND GOOSE TO BRUCELLA DISEASE.—Emmel, M. W.—Jour. Am. Vet. Med. Assoc. 77:185-197. 1930. (Journal Article No. 32 (n. s.) from the Mich. Agr. Exp. Sta.) Since it has been shown that chickens are susceptible to infection with the germ that causes infectious abortion in cattle, it was thought desirable to see if other birds were susceptible also. Accordingly, turkeys, pigeons, pheasants, ducks and geese were infected artificially with abortion bacilli and it was found that all of these birds showed various degrees of susceptibility. The disease was fatal in the turkeys only and death resulted 80-119 days after artificial exposure. The turkeys showed paleness about the head and wattles, diarrhea, and emaciation. The other birds showed only very slight symptoms of disease. It was possible to get positive agglutination tests in turkeys and pheasants. In pigeons, ducks, and geese the agglutination test varied greatly, showing very mild or no reaction when the birds were given infectious material by the mouth. The changes in the tissues observed in chickens were also observed in turkeys, pheasants, pigeons, ducks, and geese.

THE PREPARATION OF ACIDOPHILUS MILK FROM MILK PASTEURIZED BY ELECTRICITY.—Devereau, E. D.—Am. Jour. Pub. Health.—20 (9):1009-1010. 1930. (Journal Article No. 34 (n. s) from the Mich. Agr. Exp. Sta.)

Before a desirable cultured milk, such as artificial butter milk, bulgaricus milk, or acidophilus milk, can be prepared, it is necessary to reduce the bacterial content of the milk to be inoculated to a negligible quantity. Heat has been the common means, and several temperatures and exposure periods are being used.

During the past year, several phases of pasteurization of milk by electricity have been studied and, in connection with these studies, a commercial plant using the Electropure process operating at 158° to 160° F. was frequently visited. On 10 different occasions, quantities of milk treated by this process were inoculated with 2 or 3 per cent of a culture of Lactobacillus acidophilus and incubated. In every case, a desirable sour milk product resulted. The curd was fine, soft, easily broken, and very little whey expressed. The milk had a fresh sour taste, and, since the heating was not sufficient to caramelize it, there was no decided cooked flavor. This method of preparing cultured milk has several distinct advantages: (1) ease with which the milk can be prepared for inoculation, (2) whole milk can be used, (3) no special sterilizing equipment is necessary, and (4) a product with a fresh sour taste and not a cooked taste or color is produced.

RATE OF INTAKE, ACCUMULATION, AND TRANSFORMATION OF NITRATE NITROGEN BY SMALL GRAINS AND KENTUCKY BLUEGRASS.—McCool, M. M., and Cook, R. L.—Jour. Am. Soc. Agron. 22:757-764. 1930. (Journal Article No. 35 (n. s.) from the Mich. Agr. Exp. Sta.) The comparative rate of intake, by plants, of nitrogen from ammonium sulfate, urea, sodium nitrate, and ammonium phos-

phate was studied by growing oats and barley in the greenhouse in jars of Hillsdale sandy loam soil to which equivalent quantities of the fertilizer were added when the plants had attained a height of about six inches. At frequent intervals thereafter, some of the plants were cut and ground in a food chopper. The sap was then pressed out and analyzed for nitrate nitrogen.

The results presented in Tables 1 and 2 show that after such treatment the concentration of nitrate in the expressed sap of barley rapidly increased. Ammonium sulfate, urea, and ammonium phosphate were slower in their tendency to increase the nitrate content of the sap than was sodium nitrate. This was due probably to the time element involved in the change of their nitrogen to a form used by the plants.

Table 1.—The effect of different nitrogen carriers on the rate of intake and accumulation of nitrate nitrogen in barley; greenhouse studies.

Treatment	Nitrate Nitrogen in p. p. m. at various periods after treatment							
	12 hours	36 hours	60 hours	84 hours	6 days	8 days	14 days	28 days
Check	1,080	928	744	765	793	831	910	603
Ammonium Sulfate	1,070	872	928	1,070	1,259	1,456	1,330	828
Urea	1,115	1,080	950	1,184	1,542	1,500	1,632	1,040
Sodium Nitrate.	1,045	1,182	1,267	1,360	1,945	1,595	1,673	1,126

Additional experiments, with oats in the greenhouse and with wheat and Kentucky bluegrass in the field, showed the saps of these plants to be similar to that of barley in response to the application of nitrogen fertilizers.

Table 2.—A comparison of the effect of ammonium phosphate and sodium nitrate on the rate of intake and accumulation of nitrate nitrogen in barley.

Treatment	Nitrate nitrogen in p. p. m. at various periods after treatment			
	16 hours	40 hours	64 hours	112 hours
Check	237	118	58	36
Ammonium Phosphate	155	105	116	91
Sodium Nitrate	383	743	754	684

In other experiments, oats and barley were grown in complete nutrient solutions until they had attained a growth sufficient for analysis. At that time, the solution in one-half of the cultures was replaced by one containing no nitrogen.

After a period of only seven and one-half hours, the sap from plants placed in solution containing no nitrogen had suffered a decrease from over 200 to about 40 p.p.m. nitrate nitrogen.

Wheat plants were grown in sand cultures containing varying amounts of nitrate nitrogen. It was found that the green weight of

the plants increased steadily up to the highest concentration of nitrate in the cultures. In general, an increase of nitrate nitrogen in the sand cultures was accompanied by increased growth, an increase in the concentration of nitrate nitrogen, and a decrease in the concentration of phosphorus in the expressed sap of the plants.

ROOT SYSTEMS OF YOUNG CORN PLANTS IN RELATION TO FERTILIZER APPLICATIONS.—Millar, C. E.—Jour. Am. Soc. Agron. 22 (10):868-873. 1930. (Journal Article No. 38 (n. s.) from the Mich. Agr. Exp. Sta.) As a preliminary to experiments to determine where fertilizer should be placed in order to be of earliest benefit to corn, a study was made of the root systems of young corn growing on different soil types.

It was found that corn roots tend to grow almost horizontally and to remain at comparatively shallow depths when the plants are young. In muck soil, practically all the roots were within three inches of the surface at distances of six inches and nine inches from the plants. In sandy loam, the roots were virtually all within three inches and four inches of the surface at distances of six inches and nine inches from the plants, respectively. In heavy loam, the roots were deeper, being within four inches of the surface at the six inch distance and within five inches at the nine inch mark. Much deeper root penetration was found in loamy sand. Six inches from the plants the average depth of roots was four and one-half inches while nine inches from the plants the average was five inches.

From these observations, it is evident that fertilizer placed on either side of the seed and somewhat below the kernel should have an early influence on growth, as it will be in the direct line of growth of the roots.

COTTONSEED MEAL STUDIES. III. HEAVY FEEDING OF COTTONSEED MEAL TO DAIRY CATTLE DURING REPRODUCTION AND LACTATION.—Huffman, C. F., and Moore, L. A.—Jour. of Dairy Science. 13. (6) :478-494. 1930. (Journal Article No. 39 (n. s.) from the Mich. Agr. Exp. Sta.) This is the third of a series of papers on cottonseed meal feeding to be reported from the Dairy Section of the Michigan Agricultural Experiment Station. It was shown in previous papers that the liberal feeding of cottonseed meal to growing heifers along with timothy hay and corn silage did not produce symptoms of cottonseed meal injury. Also, cottonseed meal is not constipating as is commonly believed but actually has a laxative effect.

The present paper is a progress report giving the effects of heavy feeding of cottonseed meal on health and reproduction of the first generation of dairy cattle to about four years of age. The results lend further support to the theory set forth in a previous paper that cottonseed meal injury in cattle is due to a dietary deficiency caused by the lack of a factor or factors carried by good quality hay. As much as 11 lbs. of cottonseed meal were fed a day during the first few months of lactation without injury. G-1 consumed 7.1 lbs.; G-3, 7.3 lbs.; G-5, 6.8 lbs.; and G-7, 6 lbs. cottonseed meal on the average a day from first to second calving, which includes a two months dry period.

Milk production was not interfered with by the heavy consumption of cottonseed meal. G-1 produced 9,803 lbs.; G-3, 10,279 lbs.; G-5,

10,268 lbs.; G-7, 7,613 lbs.; and G-9, 10,440 lbs. of milk during the first 305 days of the first lactation period. The heavy feeding of cattle from three months to four years of age resulted in normal reproduction when compared with the check group which received linseed oil meal along with timothy hay, corn silage, and yellow corn. There was no significant difference between the two groups in size and strength of calves at birth. The heavy feeding of cottonseed meal did not increase the susceptibility of heavy milking cows to udder infection. Mastitis was not encountered among the animals of either group.

ON THE BACTERIOLOGY AND PATHOLOGY OF 500 CHICKS AFFECTED WITH PULLORUM DISEASE.—Emmel, M. W.—Poultry Science, 10 (1):24-30. 1930. (Journal Article No. 40 (n. s.) from the Mich. Agr. Exp. Sta.) Differences of opinion have existed among some investigators on poultry disease as to the significance of certain tissue changes observed in chicks. Some of these tissue changes have been regarded as typical of pullorum disease by some workers, while others have been hesitant in making diagnoses of pullorum disease based on the observation of these lesions. This work was undertaken for the purpose of throwing some light on the significance of these tissue changes.

Careful notes were made of the changes found in the lungs, heart, and other organs of chicks submitted for examination and cultures were made for pullorum germs. Judging from the results obtained, it appears that, except in acute forms of pullorum disease in baby chicks, there is a definite pathology produced upon which the disease can be diagnosed.

Gray and brownish spots, small hemorrhages, or congested areas may occur in the liver. Small gray spots, pneumonia and congestion are typical lesions found in the lungs. Firm, nodular, grey foci may appear in the musclature of the heart. Combinations of these lesions may occur in the various organs mentioned. Lesions of the liver, heart, and lungs were associated in 32.4 per cent of the chicks. Liver and lung lesions were associated in 39.6 per cent of the chicks. Liver lesions alone occurred in 15 per cent of the chicks. The causal organism was isolated from the liver of 89.2 per cent, from the lungs of 82.4 per cent, and from the heart in 74 per cent of the chicks studied.

ADSORPTION FROM SOLUTION BY ASH-FREE ADSORBENT CHARCOAL. VI. ADSORPTION OF INVERTASE.—Miller, E. J., and Bandemer, S. L.—Jour. Phys. Chem. 34:2666-2692. 1930. (Journal Article No. 41 (n. s.) from the Mich. Agr. Exp. Sta.) A study has been made of various factors which influence the adsorption of invertase by ash-free adsorbent charcoal, and of conditions which determine the properties and behavior of invertase in the adsorbed state. It has been found that the age of the invertase preparation, concentration, method of preparation, length of time of contact of charcoal with invertase, presence of acids, and previous treatment of charcoal are factors which influence the adsorption behavior of invertase. The results of this investigation clarify the anomalous and contradictory findings previously reported in the literature on adsorption of invertase by charcoal.

BREEDING CORN FOR RESISTANCE TO THE EUROPEAN CORN BORER.—Marston, A. R.—Jour. Am.. Soc. Agron. 22 (12) 986-

992. 1930. (Journal Article No. 42 (n. s.) from the Mich. Agr. Exp. Sta.) One of the principal lines of work at the Michigan State College Corn Borer Sub-station located at Monroe, Michigan, has been the testing of various strains of corn to determine whether or not any of them might, if any way, prove distasteful or repellent to the Europeon corn borer.

Although all common corn strains and crosses of common strains were unable to resist the borer, more promising results were obtained when Maize Amargo, a South American corn, was crossed with some Michigan varieties.

Heavy treatments with superphosphate speeded the growth of Maize Amargo, a late maturing corn, sufficiently, so that it was used successfully as a male parent in making crosses with Duncan, Golden Glow, and Red Cob Ensilage. Each cross produced a few kernels, some of which was furnished F. D. Richey of the U. S. Bureau of Plant Industry. The remainder of this seed was planted in 1927. A few plants grew from each cross, were inbred by hand pollinization, and produced seed.

In 1928, all the seed of these inbred strains, when planted, showed a decidedly lower infestation than the Michigan parent, and more nearly approached the lack of infestation of Maize Amargo, according to counts made by C. B. Dibble of the Entomology Section, counts being based on the number of plants found infested with corn borers and the number non-infested. All plants in these plats were inbred.

In 1929, when the seed from these plants inbred for three generations was planted in separate rows, the plants in some plats carried no borer infestation whatsoever, while those in adjacent plats were infested.

There seemed to be no difference in appearance between the non-infested rows and those with infestation present, although some of these carried as high as 50 per cent infestation. These F_3 inbreds included 935 families, of which 708 were infested by the borer and 227 were not. The ratio, then, is 3.1:1, a proportion which approaches very closely to a simple 3:1 Mendelian ratio.

What causes this resistance is unknown but furnishes an interesting problem for future study. These F_3 non-infested strains will be used in an attempt to produce a corn variety to be grown in borer infested regions, which will be resistant to the ravages of the borer, and also be of high quality and productivity. The earliest crosses were with Duncan, Golden Glow, and Red Cob Ensilage but crosses with other varieties of corn are now being handled in a similar way.

EPIDERMOID CANCERS ON THE FEET OF WILD BIRDS.—Emmel, M. W.—Jour. Am. Vet. Med. Assoc. 77:641-643. 1930. (Journal Article No. 46 (n. s.) from the Mich. Agr. Exp. Sta.) During the last few years, tumorous lesions have been noted on the feet of wild birds caught for banding purposes. These tumors involved the skin of the foot, both on the ventral and dorsal surface. The birds affected were three slate-colored Juncos and the tumors were of the nature of cancers affecting the outer layer of the skin. No indication was found to show that these tumors were malignant. It is possible that the cause of these tumors might be some sort of a physical injury.

THE INTERAGGLUTINABILITY OF MEMBERS OF THE BRUCELLA AND PASTEURELLA GENERA.—Mallmann, W. L.—Jour Am. Vet. Med. Assoc. 30 (5): 636-638. 1930. (Journal Article No. 51 (n. s.) from the Mich. Agr. Exp. Sta.) The finding of Brucelliasis in cows, goats, humans, sheep, chickens, and horses has been reported in recent years. The apparent universality of these organisms as measured largely by the agglutination test has brought up the question of specificity of the test itself. The writer, knowing the close morphological relationship among the genera Brucella, Pasteurella, and Pfeiferella, selected representative members of these groups for study. These groups were also selected because of their frequent occurrence in the aforementioned animals, both under normal and pathological conditions.

Using an immune serum prepared by injecting a rabbit with Brucella abortus bacterin, antigens prepared from Brucella abortus, Pasteurella boviseptica, Pasteurella avicida, Pasteurella suiseptica, and Pfeiferella mallei were examined for agglutinability. The results, as presented in Table I, show a close interagglutinability of the organisms tested.

Table I.—Cross-aggulation studies with immune Brucella Abortus rabbit serum by members of the Brucella, Pasteurella, and Pfeiferella groups.

Antigen	Control	Serum Dilutions					
		'1-50	'1-100	'1-200	'1-400	'1-800	'1-1,600
Brucella abortus	–	++++	++++	++++	++++	++++	++++
Pasteurella avicida	–	++++	++++	++++	++++	++++	++++
Pasteurella boviseptica	–	++++	++++	++++	++++	++++	++++
Pasteurella suiseptica	–	++++	++++	++++	++++	++++	++++
Pfeiferella mallei	–	++++	++++	++	+	+	–

Using an immune serum prepared by injecting a rabbit with Past. boviseptica bacterin, members of Pasteurella and Brucella were examined for agglutinability. The results obtained were similar to those obtained with a positive Brucella abortus serum. Using naturally infected cow serum, similar results were also obtained.

The data show that Brucella immune sera agglutinated Pasteurella and Pfeiferella antigens and that Pasteurella immune serum agglutinated Brucella antigens.

ECONOMIC RELATIONSHIPS AND SOCIAL CONFLICT.—Hoffer, C. R.—Pub. Am. Sociological Soc. 24 (4):3-8. 1930. (Journal Article No. 58 (n. s.) from the Mich. Agr. Exp. Sta.) Conflicts between farmers and business men are comprehensive in scope and originate in circumstances that exist in many communities. The conflict described in this paper occurred in a progressive rural community in 1920 and the following years. Outwardly, there was no sign of trouble but close acquaintanceship with the community revealed the fact that farmers were antagonistic toward business men in the town. The causes of this antagonism appeared to be: (1) the emotional tension created by the agricultural depression; (2) a disparity in the decline of prices of agricultural products and of merchandise; (3) a prejudice in favor of farmers on the part of the county agricultural agent; (4) the develop-

ment of interests and programs in the town independently of the rural territory around it; (5) the expansion of the Chamber of Commerce program. The issues in this conflict were not brought to a definite head. Instead, farmers avoided contact with business men whenever possible, and community leaders tried to keep this action on the part of farmers out of public discussion. In time, however, one group of professional men, the physicians, were involved in the conflict mainly because they decided to make a transportation charge in addition to fees for professional calls in the country.

An analysis of this situation suggests that conflicts in rural communities may be divided into two types: the active and the passive. Those belonging to the first type are dramatic and intense, whereas those belonging to the second type have the opposite characteristics. The circumstances in the community under consideration suggest further that conflict is likely to arise between farmers and business men when a town in rural territory becomes large enough to have interests and programs not directly related to the remainder of the community. These interests probably do not become significant until the town has a population of approximately 5,000. Finally, the turn of events in this community illustrates the fact that emotion and prejudice associated with conflict are necessarily more ephemeral than mutual relationships existing between groups in a community.

The Bulletins of this Station are sent free to such individuals as may request them. Address all applications to the Director, Agricultural Experiment Station, East Lansing, 'Michigan.

LIST OF AVAILABLE BULLETINS

Regular Bulletins—

262 Suggestions on Planting Orchards.
264 Second Report of Grade Dairy Herd.
267 Michigan Weeds (only to Michigan libraries and teachers. Others 25c).
277 Studies in the Cost of Market Milk Production.
281 Beautifying Farm Home Grounds.
284 Some Information and Suggestions Concerning the Use of Phosphorus.
286 Studies and Cost of Milk Production—No. 2.

Special Bulletins—

71 Studies in the Range and Variation of the Per Cent of Butter Fat in the Milk of Individual Cows.
83 Key to Orthoptera of Michigan.
90 Special Report of the Upper Peninsula Experiment Station.
91 Lime for Michigan Soils.
94 The Financial History of a Twelve-Year-Old Peach Orchard.
98 Vinegar.
100 Soy Beans.
101 Oats in Michigan.
106 Sugar Beet Growing in Michigan.
107 Diseases of Bees in Michigan.
110 Special Report of the Upper Peninsula Experiment Station.
111 Studies in City Milk Distribution.
120 The Microscopic Identification and Determination of the Specific Ingredients in Stock Feeds.
123 Second Growth Hardwood Forests.
124 The Colorimetric Hydrogen-ion Determination as a Means of Locating Faulty Methods at City Milk Plants.
125 Michigan Potato Diseases.

†This is a popular bulletin on the identification of the more common disorders of tree fruits in Michigan. It should be found generally useful as a work of reference for practically everyone interested in the raising of fruit.

Because of the unusual expense of the color plates it will not be distributed to the entire mailing list but will be sent to those who specifically request it, upon the receipt of ten cents (coin or stamps).

167 Chicory Growing in Michigan.
169 Profit and Loss in Pruning Mature Apple Trees.
170 The Detroit Milk Market.
171 Farmers' Co-operative Buying and Selling Organizations in Michigan.
172 Farm Real Estate Assessment Practices in Michigan.
173 The Principal Bulb Pests in Michigan.
174 Spraying Calendar.
175 The Rural Cemetery.
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177 The Significance of Soil Variations in Raspberry Culture.
178 Michigan Raspberry Diseases.
179 Forest Insurance and Its Application in Michigan.
180 The Soils of Michigan, Grayling Sand.
181 A Study of Town-Country Relationships.
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201 The Influence of Sugar and Butterfat on the Quality of Ice Cream.
202 The Propagation of the Highbush Blueberry.
203 Spraying Materials and the Control of Apple Scab.

***204 Investigations of Corn Borer Control at Monroe, Mich.**
***205 Soil Fertilization for Sugar Beets.**
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***211 A Comparison of Alfalfa Strains and Seed Sources for Michigan.**

Circular Bulletins—

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47 Poisoning from Bacillus Botulinus.
48 Spraying for Hopperburn.
49 The Hessian Fly.
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56 Lime Requirement for Cass County.
57 Lime Requirement for Calhoun County.
58 Lime Requirement for Berrien County.
59 Lime Requirement for Ottawa County.
60 Lime Requirement for Kalamazoo County.
61 Paying for Milk on a Quality Basis as a Means of Improving the Supply.
62 The Simplex Lime Spreader.
64 Simple Water Systems.
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68 The Cherry Leaf Beetle.
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75 Fertilizer Suggestions for Ingham County Soils.
76 Fertilizer Suggestions for Isabella County Soils.
77 Fertilizer Suggestions for Kalamazoo County Soils.
78 Fertilizer Suggestions for Livingston County Soils.
79 Fertilizer Suggestions for Macomb County Soils.

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80 Fertilizer Suggestions for Muskegon County Soils.
81 Fertilizer Suggestions for Ottawa County Soils.
82 Fertilizer Suggestions for St. Joseph County Soils.
83 Fertilizer Suggestions for Van Buren County Soils.
85 Honey Vinegar.
87 Apple Maggot.
88 Fertilizer Suggestions for Calhoun County.
90 Cucumber Culture.
91 Arbor Day Programs for Rural Schools.
93 "Sting" on Apples.
94 Fleas and Bed-Bugs.
95 Feeding Minerals to Dairy Cattle.
96 Seed Corn Curing and Storing.
97 Cottage Cheese.
98 How to Make and Preserve Cider.
99 House Plants.
100 Michigan Farmers Tax Guide.
101 Cockroaches, Silver-fish, and Book-lice.
102 Farm Lease Systems in Michigan.
103 Prevention of Wind Injury to Crops on Muck Land.
104 Clothes-Moths and Carpet Beetles.
105 Sweet Corn.
106 Flies Commonly Found in Dwellings.
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108 Organic Matter in Berrien County Soils.
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117 Distribution of Acid Soils, Muskegon County.
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124 The Young Vineyard.
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126 Essentials of a Mulch Paper Laying Machine.
127 Pruning Young Fruit Trees.
128 Undulant Fever in Man and Abortion Disease in Cattle.
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130 Cultural Methods in the Bearing Vineyard.
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2 The Babcock Test.
4 The Home Vegetable Garden.
13 Oat Smut and Its Control.
17 The Stinking Smut of Wheat
19 Grasshopper Control.
20 Hotbeds and Cold Frames.
22 Effective Crop Exhibits.
23 Alfalfa.
24 Utilizing Poles and Timber in Farm Buildings.
25 Feeding Cull and Surplus Potatoes.
26 Swine Feeding.
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32 Bull Pen and Safety Breeding Chute.
***33 Bigger Dairy Profits Through Dairy Herd Improvement Associations.**
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58 Culling the Farm Flock.
59 Methods of Control for the European Corn Borer.
60 Insect and Disease Control in the Home Orchard and Vegetable Garden.
67 Producing Sugar Beets.
68 A 10′ x 12′ Portable Brooder House.
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84 Growing Sweet Corn for the Canning Factory.
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17 Dairy Club Work.
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19 Forest Planter's Handbook.

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33 A Study of the Presence of Bacterium Abortus (Bang) in Milk.
34 A Study of the Factors Which Govern Mating in the Honey Bee.
48 The Lecania of Michigan.
50 Rate and Extent of Solubility of Minerals and Rocks Under Different Treatments and Conditions.
59 Flat Sours.
60 The Influence of Manufacturing Operations on the Bacterial Content of Ice Cream.
61 The Relation of High Cellular Counts to Bacterium Abortus Infection of the Udder.

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62 Some Physical and Chemical Properties of Several Soil Profiles.
64 The Salt Requirements of Marquis Wheat in Water Culture for the Vegetative Phase of Development.
65 Studies on a Non-Virulent Living Culture of Bact. Abortus Towards Protective Vaccination of Cattle Against Bovine Infectious Abortus (Bang's Abortion Disease).
66 The Significance of Bacterium Abortus Antibodies (Agglutinins and Complement-fixing) Found in the Sera of Calves at Birth or After Nursing.
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68 Bacterium Pullorum.
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90 The Breeding of Strains of A-Tester Yellow Dent Corn.
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96 A Local Farm Real Estate Price Index.
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***109 A Contribution to the Bacteriology and Pathology of Bovine Udder.**

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Special bulletins are of a popular nature, and deal with special lines of work.

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Technical bulletins, as the name implies, are devoted to reports of scientific research and designed more especially for use of other investigators, instructors and students.

The Quarterly bulletin contains contributions by all sections of the

*Bulletins listed in bold faced type are recent publications of this Station.

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Graham Station, Kent County, 50 acres donated by R. D. Graham; 50 acres purchased, Walter Toenjes, Superintendent.
Dunbar, Chippewa County, Forestry Station, 577 acres deeded, Putnam Robbins, Superintendent.
Lake City Experimental Potato Farm, Missaukee County, 640 acres purchased or under contract. Ashley Berridge, Superintendent.
Kellogg Demonstration Farm and Wild Life Sanctuary, Kalamazoo County, 900 acres donated by W. K. Kellogg; C. M. McCrary, Superintendent.
Monroe, Monroe County, Corn Borer Station, 7½ acres rented.

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CONTRIBUTIONS BY ALL SECTIONS OF THE
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SUDAN GRASS IS VALUABLE PASTURE CROP IN MICHIGAN

This Crop Furnishes Forage During Drought and at Seasons When Native Grasses Stop Growing

A. B. DORRANCE, SECTION OF FARM CROPS, MICHIGAN EXPERIMENT STATION, AND OFFICE OF FORAGE CROPS AND DISEASES, U. S. DEPARTMENT OF AGRICULTURE, COOPERATING

That Sudan grass is of exceptional value as an emergency summer pasture crop in Michigan was indicated in experiments conducted during 1929 and 1930, two of the driest years which this State has ever experienced. These experiments are a part of an extensive program of pasture investigations under way at the W. K. Kellogg Farm at Augusta, Michigan.

The work is being carried on cooperatively by the Office of Forage Crops and Diseases of the United States Department of Agriculture and the Farm Crops Section of the Michigan Experiment Station.

In 1929, Sudan grass, Dwarf Essex rape, Utah common alfalfa, biennial white sweet clover, and Sudan grass seeded with sweet clover were sown in duplicate one acre plots laid out in narrow strips on a rolling Bellfontaine sandy loam soil. An application of 4,500 pounds per acre of finely ground limestone was made, after plowing, to meet the lime requirement of the soil as indicated by Soiltex. Due to frequent heavy rains in April and early May, none of the plots were seeded until May 28 and 29 at which time 300 pounds per acre of 2-12-6 fertilizer was drilled with the seed. A fertilizer somewhat higher in nitrogen would probably have been more desirable for the Sudan grass, while one carrying more potash was indicated in the case of the alfalfa and sweet clover seedings. Sudan grass was sown at the rate of 30, rape 12, sweet clover 20, and alfalfa 20 pounds per acre; all of these rates are somewhat greater than those usually recommended.

Dry weather began immediately after the seed was in the ground and, except for one rain in mid-July, the drought was unbroken until October. However, good moisture conditions and warm weather at the time of planting gave each of the crops an equally vigorous start.

The plots were grazed with equal numbers and weights of mature Shropshire ewes with lambs. Grazing was started when the rape was 10 to 12 inches high while the Sudan grass was over four feet tall and in blossom. The leaves of the Sudan grass were abundant but the stalks were rather coarse. Grazing might better have been started when the plants were much smaller but the sheep could not be turned into the paddocks earlier because of an unavoidable delay in fencing.

The attempt to get a seeding of sweet clover in the Sudan grass had to be written off as a failure. In the beginning, the sweet clover started off as well with the Sudan grass as it did alone. In four or five weeks, however, the Sudan grass grew away from the sweet clover and used so much of the available moisture and plant food that the sweet clover failed to thrive. Then the sheep were turned in and they nipped the tender sweet clover seedlings off right down to the ground and they never recovered.

The sheep were weighed three consecutive days before being turned into the paddocks and the average of these three weights was taken as the initial weight of each animal. After having grazed on the experimental plots for 10 days, all animals were weighed again. The gains were approximately equal for each group of sheep except that the nursing lambs gained slightly faster on the rape than on the Sudan grass. Ten days of pasturage had finished the rape on one plot but its duplicate acre still had enough forage left to justify turning in four head of sheep. Extra sheep were turned into the Sudan grass paddocks. These plots were then pastured until August 23 after which, owing to the very severe drought, no further grazing was available. The amount of pasturage furnished by each crop is given in Table 1 in terms of sheep-days; a sheep day being pasture for one mature sheep for one day. Two lambs were calculated as being equal to one mature sheep.

Table 1.—Sheep-days grazing furnished by emergency pasture crops at W. K. Kellogg Farm, 1929.

Crop	Number of Sheep-days Pasturage
Sudan grass seeded to Sweet Clover	388
Sudan grass alone	360
Dwarf Essex rape	158

Under the conditions of this experiment, the difference between Sudan grass seeded to sweet clover and Sudan grass alone is not considered significant, but it is noteworthy that Sudan grass, under these conditions, furnished more than twice as much pasturage as rape and it kept the sheep in essentially the same condition.

In the case of the 1929 alfalfa and sweet clover plots, no worth-while growth was made and no grazing was attempted.

1930 Trials

The 1930 plots included seedings of rape, alfalfa, and sweet clover made April 12. The attempt to seed sweet clover in Sudan grass was not repeated. Instead rape in 21 inch rows at two pounds per acre was seeded. The broadcast rate of seeding rape was cut to six pounds per acre. Sudan grass was sown May 21. With very cool weather during the balance of May, its early growth was somewhat retarded.

Five head of mature Shropshire ewes were turned into each of the rape plots July 3, and the same number into the alfalfa, sweet clover, and Sudan grass plots July 11. Then came another season of drought. The drought of 1930 was longer and more severe than that of 1929, but a better quality of grazing was obtained from the pasture plots because of earlier seedings.

Weights of the ewes taken at 15-day intervals indicated that they were keeping in substantially the same condition on all plots. Changes in numbers of animals were made in keeping with available pasture. Some were added to the Sudan grass and sweet clover paddocks and some had to be removed from the rape. This crop suffered in both 1929 and 1930 from a heavy infestation of plant lice. The sheep were temporarily removed from all plots August 18. They were returned September 8th, four per acre on Sudan grass, three on alfalfa, two on sweet clover, and one or two on the rape plots. All were removed from the experimental pasture paddocks for the balance of the season on September 25.

The sheep-days of grazing secured from the various crops in 1930 are given in Table 2.

Table 2.—Sheep-days grazing furnished by emergency pasture crops at the W. K. Kellogg Farm, 1930.

Crop	Number of Sheep-days Pasturage(1)
Sudan grass(2)	342 5
Sweet clover (1930 seeding)	286 0
Rape (Broadcast)	249 0
Alfalfa (1930 seeding)	241 0
Rape (In 21-inch rows)	162 0

(1) Average of duplicate plots.

(2) One of the Sudan grass plots lay adjacent to a body of timber which cut its yield. The other plot furnished over 400 sheep-days grazing.

Sudan Grass Pasture For Dairy Cows

Considering six mature ewes equal to one cow, the 1930 Sudan grass plots may be considered as having had a carrying capacity of one cow per acre from July 11 to September 5. To pasture one cow for that same period on the other crops would have required approximately 1.2 acres of the new sweet clover seeding, 1.4 acres of the broadcast rape, 1.4 acres of the alfalfa seeding, and 2.1 acres of the rape in rows. This carrying capacity may seem low but it must be remembered that the soil was an infertile sandy loam and the summers of both 1929 and 1930 were unusually dry. Permanent pastures on the W. K. Kellogg Farm were practically non-productive during this period. Several Michigan farmers have reported experience with Sudan grass which carried two cows per acre from early July, until frost. This experiment does point out relative grazing value of these crops under adverse conditions.

As a matter of fact, the W. K. Kellogg Farm has been making practical use of Sudan grass as pasture for its herd of Guernseys. Pasture is usually scarce during July, August, and September on the thin droughty soils predominating on this farm. The shortage of grazing from permanent pastures was intensified by the very severe droughts of 1929 and 1930. The Sudan grass for the dairy herd was sown in fields near the barn where it could be used conveniently for both day and night pasture. Superintendent C. M. McCrary of the W. K. Kellogg Farm states that, without this supplement to the permanent pastures, barn feeding, with its added labor and expense would have been inevitable. The carrying capacity of the Sudan grass used for the dairy

cows was approximately the same as that of the experimental plots grazed with sheep, that is, nearly one cow per acre for July, August, and part of September.

Mr. McCrary points out these advantages of the Sudan grass pasture as used for the dairy herd on the W. K. Kellogg Farm in 1929 and 1930.

1. Day and night pasture was provided near the barns.
2. High grade succulent pasture was provided during July, August, and most of September when permanent pastures afforded no grazing.
3. Heavy barn feeding was avoided at a considerable saving of labor and expense since the cows gathered the Sudan grass for themselves.

Sudan grass was introduced into the United States by explorers of the United States Department of Agriculture in 1909. It came from

Fig. 1.—Weighing sheep to obtain data on grazing. 1930 grazing plots in background.

that semi-tropical desert part of Africa known as Sudan. The seed supply is now produced mainly in the dry region centering around northern Texas and western Kansas. Sudan grass is a hot weather and warm soil plant not adapted to those sections where very cool weather or frosts are to be expected in mid-summer. It fits best into the average northern corn belt farm program as a supplementary pasture.

There may be some danger of pasturing Sudan grass after it has been frosted due to possibilities of prussic acid poisoning. Until recently, there was thought to be some danger, from the same cause, after prolonged drought. Recent research in Australia indicates that there is no danger in pasturing pure Sudan grass although there may be some from the sorghums.

Rape, because of its lower crude fiber content, greater succulence

and palatability, is better suited as a hog pasture than Sudan grass. Its comparative productivity should show to greater advantage on more fertile soil and under more favorable moisture conditions than obtained in the experiments reported herewith. Rape also will endure more cold and provide a longer grazing season. However, it suffers seriously from plant lice, requires soil in a higher state of fertility than is needed for Sudan grass, and is not favored as a pasture for dairy cows because of the danger of tainting the milk.

One might infer from the 1930 results in these experiments that new seedings of sweet clover were competing favorably with Sudan grass and rape. It should be noted that a considerable portion of the pasturage available in the sweet clover and alfalfa seeding paddocks was weed growth; also, in these trials, these legumes were grazed so closely as to lessen greatly the possibility of a stand the following season. Both sweet clover and alfalfa require a soil well supplied with lime. To furnish any considerable grazing during the first year these crops would have to have a more fertile soil and much more moisture than was available at this station under conditions where Sudan grass provided very worthwhile pasture.

According to earlier experiments conducted by the Michigan Experiment Station at East Lansing, Michigan,[1] Sudan grass should be sown the latter part of May or the first week in June on a seed bed prepared in the same manner as for small grain. A grain drill set to sow two pecks of wheat to the acre will distribute 20 to 25 pounds per acre of Sudan grass seed, a desirable rate of seeding. It should be ready for grazing about six weeks after it is planted.

Acknowledgements

The writer acknowledges with appreciation the co-operation of C. M. McCrary, Superintendent of the W. K. Kellogg Farm of the Michigan State College in making arrangements for the labor and livestock used in these experiments; also the advice and direction in the handling of the livestock, freely given by members of the section of animal husbandry of the Michigan Experiment Station.

METHOD OF COMPUTING MACHINERY COSTS

E. C. SAUVE, DEPARTMENT OF AGRICULTURAL ENGINEERING

Competition in the field of agriculture has caused many farmers to analyze their business in the desire to reduce production costs. According to the 1925 agricultural census, the total value of agricultural machinery on Michigan farms is over ninety-six million dollars. While this amount represents only 6 per cent of the total farm value, it is nevertheless significant.

[1]C. R. Megee—"Emergency Hay and Pasture Crops," Special Bulletin No. 150, Agricultural Experiment Station, Michigan State College, reprint March, 1930.

There are but few who will doubt the effectiveness of machinery in crop production with respect to labor saving. Most owners likewise will admit that machinery on the average Michigan farm is not used as efficiently as it should be. The presentation of the graph on overhead costs is made to appraise the farm owner of the necessity to make more efficient use of his machinery in order that the charges against machinery may be decreased.

Machinery costs may be divided into two classes called operation costs and overhead costs.

Operation Costs

Operation costs can be readily calculated. This cost usually consists of labor alone but in case of power equipment would also include such items as fuel oil and grease.

Overhead Costs

Overhead costs are not so well understood and it is the purpose of this article to present this phase of machinery costs. Overhead costs are classified here as: (1) depreciation; (2) interest on investment; (3) repairs, and (4) taxes, housing, and insurance.

1. Depreciation equals the initial investment divided by the estimated years' life or depreciation equals $\frac{I}{Y}$

2. Interest on investment equals 6 per cent of the average investment which may be accurately expressed as follows: Interest equals $\frac{.06 \times I\ (Y + 1)}{2Y}$; where I equals the initial investment and Y the number of years estimated life.

3. Repairs are based on an annual rate of 4 per cent of the initial investment or repairs equals $.04 \times I$.

4. Taxes, housing and insurance are based on a straight 2 per cent per annum of the initial investment. Thus taxes, housing and insurance equal $.02 \times I$.

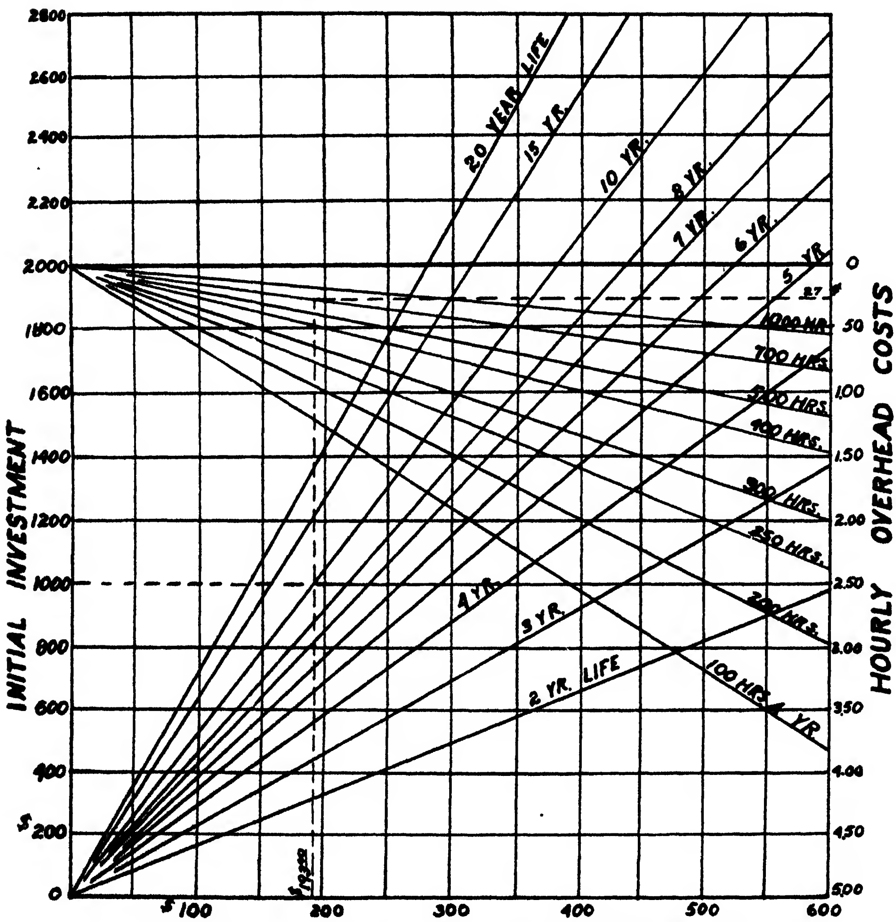
Adding 1, 2, 3 and 4 together the following equation is obtained: Total overhead costs equal $\frac{I}{Y} + \frac{.06 \times I\ (Y + 1)}{2Y} + .04I + .02I$. Reducing to a common denominator and combining the values the formula becomes: Total overhead cost equals $\frac{I\ (1.03 + .09Y)}{Y}$.

The graphic representation of overhead costs has been developed from the above equation. There are a great number of variables associated with machinery costs. It would be absolutely impossible to determine exact costs until the machine was junked or otherwise disposed of. Cost estimates should be known at the beginning of the machines use. It is believed that by the method furnished here it is possible, by supplying the value of estimated life in years to the formula, to determine a reasonably accurate figure for cost computation.

It will be noted according to step No. 3 that repairs are based on a straight 4 per cent of the initial investment. When accurate cost figures on repairs are known, it can be indicated as follows:

Referring to the graph it will be found that a machine which costs $1,000 and which has an estimated life of 10 years represents a yearly overhead cost of $193.00. This figure is found by locating in the left margin the value representing $1,000 initial investment. Trace hori-

OVERHEAD COSTS
OF MACHINERY



YEARLY OVERHEAD COSTS $= \frac{I(1.03+.09Y)}{Y}$

I = INITIAL IVESTMENT

Y = YEARS ESTIMATED LIFE

zontally as shown by the dotted line until it intersects the 10 year life line. Drop a vertical line from this intersection to the base line and read the approximate value of $193 representing yearly overhead cost.

This value of $193 includes an amount for repairs which is 4 per cent of the initial investment. Therefore $193. — (.04 × 1000) = $153 yearly

overhead cost less repairs. $153 + actual repair for year equals total yearly overhead costs.

For Machinery Costing Less Than $200

The average cost of the general line of farm machinery would be less than $200. In order to interpret overhead costs from the graph accurately on machinery priced under $200, it will be necessary to make some calculation as follows:

Multiply the initial investment by 10 and follow chart as for the example given below. Divide the result in the yearly overhead column by 10 to secure the correct answer. The example follows:

A double drum hay loader costing $130.00 has an estimated life of 15 years. What is the yearly overhead cost?

$\$130.00 \times 10 = \$1300.00$.

Trace the $1300.00 investment line on graph to the 15 year life line. Drop a line from this intersection to the base line which reads approximately $206.25.

$\$206.25 \div 10 = \$20.62$ annual overhead costs of a $130.00 hay loader.

By using the formula direct, yearly overhead costs $= \dfrac{I\ (1.03 + .09Y)}{Y}$

Yearly overhead costs $= \dfrac{\$130.00\ (1.03 + .09 \times 15)}{15} = \dfrac{\$130.00 \times 2.38}{15}$

$= \$20.62$.

Hourly Overhead Costs

Having determined the yearly overhead costs from the chart follow the line upward to the "hours a year" line. Follow a line from the intersection of these lines horizontally to the right margin and read value of hourly overhead cost. The same answer can be obtained by dividing the yearly overhead cost by the estimated number of hours used during the year.

SELECTING THE ELECTRIC MOTOR FOR PUMPING WATER

W. H SHELDON, SECTION OF AGRICULTURAL ENGINEERING

The fractional horsepower motor is rapidly replacing the windmill and the gasoline engine as a means of power for pumping water on the farm because it is economical, dependable, and easy to control. For pumping water, a motor should be used which can start under full load and quickly bring its load up to speed. Most of the cheap motors such as are used on washing machines are of the split phase type and are not suitable for pumping water because they consume approximately seven times their normal running current while starting and they lack overload starting ability even with the high starting current. Due to this high starting current, these motors are likely to burn out in starting a pump and a fuse can not protect them against overload.

The repulsion-induction motor will start and bring up to speed twice its rated load with approximately twice its normal running current at the start. Furthermore, a fuse can adequately protect it against overload. Because of these features, the repulsion induction type motor is well adapted for pumping water and is universally used by manufacturers of water systems.

Extension Bulletin No. 69, "A Simple Electric Water System," explains how a gravity water system may be built by using the windmill type of force pump with a jack and electric motor. With this system, fresh water may be obtained direct from the well by turning a switch conveniently located by the kitchen sink. By using a range boiler for a pressure tank and an automatic switch, the system will automatically maintain a pressure of 20 to 40 pounds.

The size of motor required is determined by the amount of water to be pumped per minute and the distance the water is raised. Theoretically, the horsepower required would be as follows:

$$\frac{\text{Gallons per minute} \times 8.33 \text{ (lbs. per gallon)} \times \text{total elevation in ft}}{33{,}000 \text{ (foot lbs. in 1 horsepower)}}$$

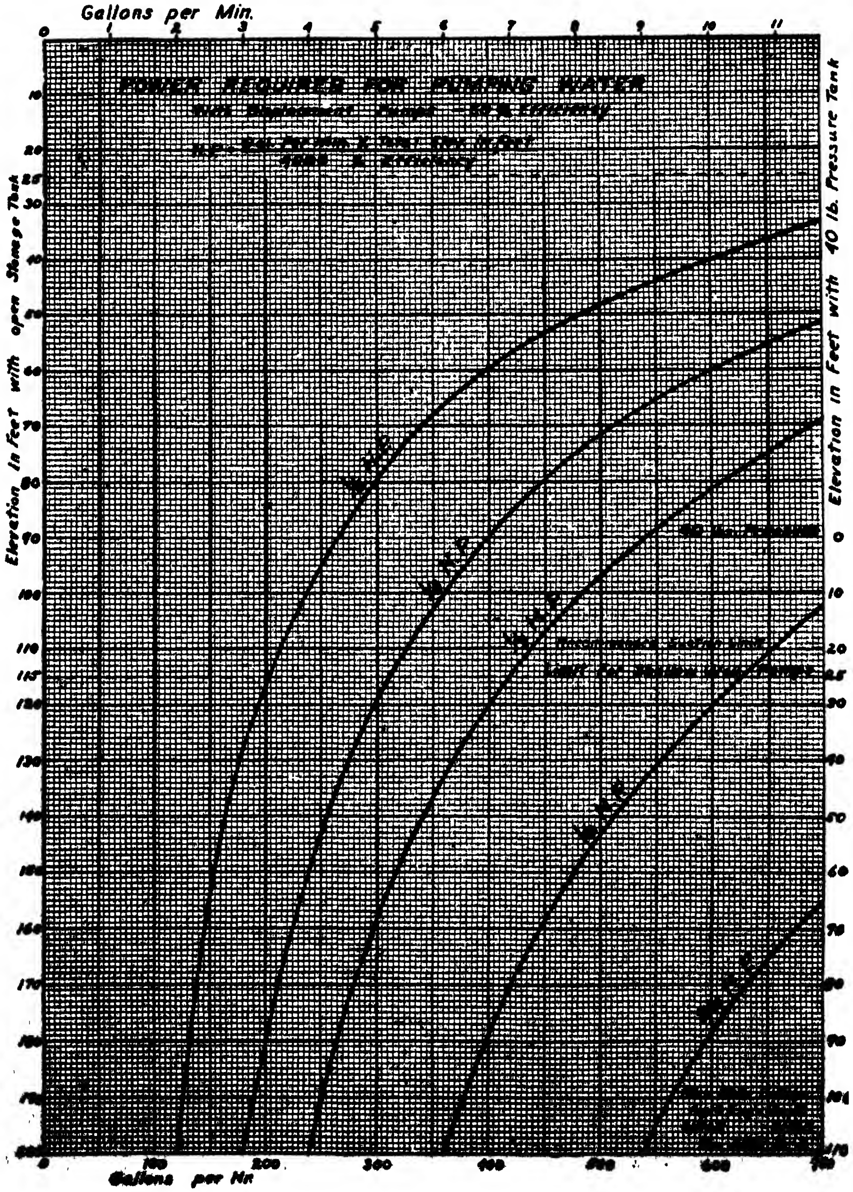
Like all other machines a pump has friction and since $\frac{8.33}{33{,}000}$ is approximately equal to $\frac{1}{4{,}000}$ we have the formula simplified as shown on the graph (Figure 1). The mechanical efficiency of displacement pumps ranges from about 40 to 80 per cent. Sixty per cent being a fair average, it was used for this graph. This, however, is a little high for windmill force pumps because of the difficulty in keeping the guides properly lubricated. The total elevation in feet includes the suction lift losses due to friction of water in the pipes, and the vertical distance the water is forced after it leaves the pumping cylinder. If a pressure tank is used, 2.3 feet elevation should be allowed for each pound of pressure or 90 feet for 40 pounds (See Fig. 1).

The vertical suction limit of a pump is 25 feet but due to wearing of leathers and the possibility that the water level in the well may lower, the recommended suction limit is 20 feet. Any pump that has either a vertical or horizontal cylinder built into the working head is classed as a shallow well pump and may be installed at any convenient place as long as the vertical distance above the water plus the pipe friction does not exceed the suction limit of the pump. The deep well pump is designed to raise water from depths greater than 20 feet. It is able to do this by having the cylinder placed down in the well and connected to the working head by means of a pipe and plunger rod. In all cases, the deep well pump must be located over the well.

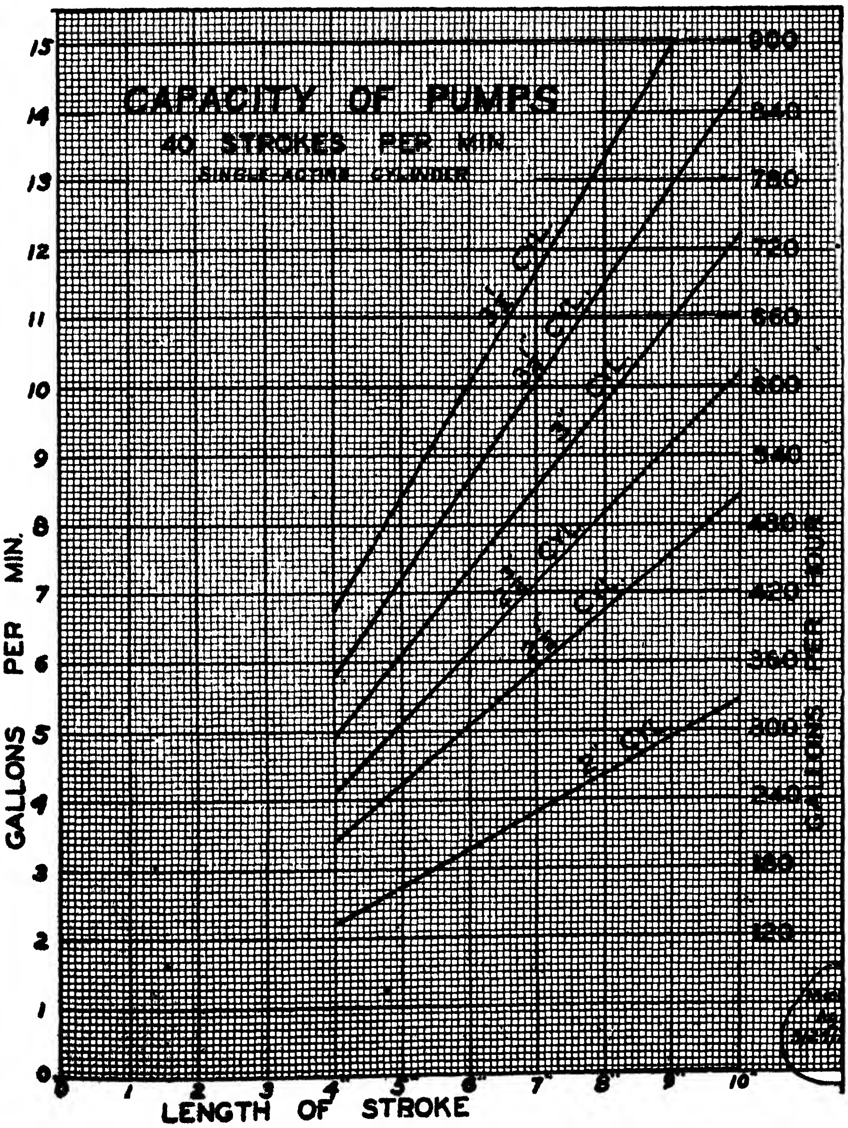
The capacity of a pump depends on the size of the cylinder, length of stroke, and the number of strokes per minute. Figure 2 gives the capacity per minute and per hour for the sizes of cylinders in common use with various lengths of strokes at the recommended speed of 40 strokes per minute. For example, a two and one-half inch cylinder with a six inch stroke will deliver five gallons per minute or 300 gallons per hour. Figure 1 shows that a one-fourth H. P. motor will be required to raise this water 25 feet and force it into a pressure tank with a maximum pressure of 40 pounds.

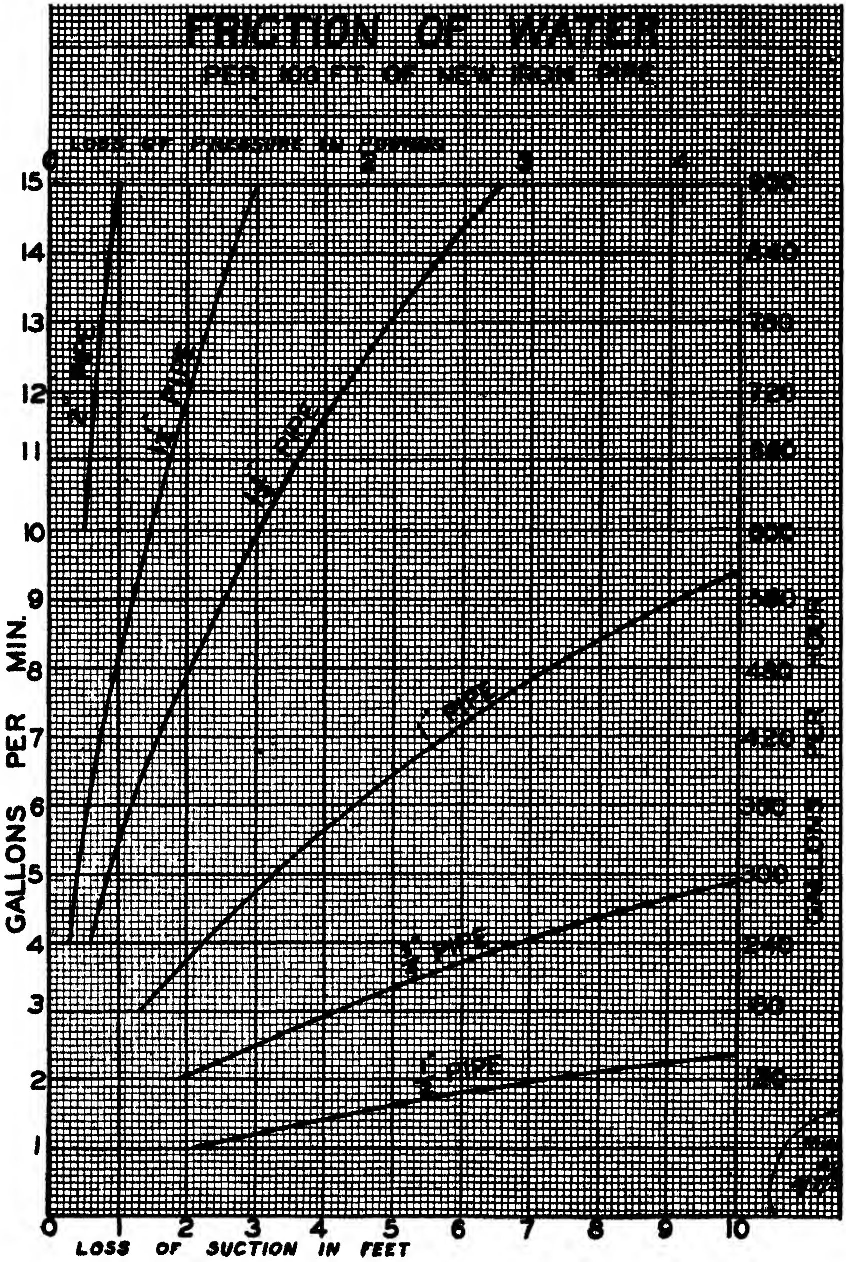
This graph shows the power requirements of shallow well water systems with a maximum pressure of 40 pounds are as follows:

200 gallons per hour, 1/6 H. P.
300 gallons per hour, 1/4 H. P.
400 gallons per hour, 1/3 H. P.
600 gallons per hour, 1/2 H. P.



Whenever a shallow well pump is installed in the basement of the dwelling and the well is at some distance from the house, the friction of the water in the suction pipe has the same effect as lowering of the water in the well. It is necessary that the suction pipe be large enough to carry the water to the pump without excessive friction losses. Suppose, for example, that a shallow well pump with a capacity of 300 gallons per hour is installed in the basement 15 feet above the water level in the well. If the pump is 150 feet from the well, how large must the suction pipe be? Figure 3 shows that for every 100 feet of one





inch pipe the suction loss is 3.3 feet or approximately five feet of loss for 150 feet of pipe. Adding this loss to the 15 feet of vertical suction, our total suction is 20 feet, the recommended limit. If the distance from the pump to the well were over 200 feet, a larger pipe would be economical.

THE VALUE OF PLANT AND TIP SELECTION IN THE PROPAGATION OF THE BLACK RASPBERRY

STANLEY JOHNSTON, SECTION OF HORTICULTURE

In 1927, an experiment was started with the Cumberland black raspberry with two objectives in mind: (1) To determine if the size of the rooted tip had any influence on subsequent yields; and (2) To determine whether or not tips from a parent plant having a high production record are more likely to give rise to progeny of high yielding quality than tips taken from average, or even relatively unproductive, healthy plants.

Method of Procedure

Individual records were kept on 105 Cumberland plants for a period of three years, 1925-27. These were selected from a field of over a thousand to represent the range in vigor and productivity presented by the entire population. Special care was taken to choose only plants that were free from disease. Tips were then rooted from low and high producing individuals and were used as the source of plants for this experiment.

The rooted tips were dug and washed free of soil. The old piece of cane, or handle, was cut off at the point where the first roots appeared. They were then shaken free of water and weighed to the nearest sixteenth of an ounce and sorted into grades based on size. The tips were set four feet apart in rows that were seven feet apart in a field of black sandy soil of reasonable uniformity and fair fertility. A record which showed the location of each tip, its weight, and the number of the parent plant from which it was propagated was made of the planting.

The young plants made a uniform start and a satisfactory growth the first year. During the summer, the new growth was measured. The following spring the plants were given the ordinary pruning afforded young plants; the canes were cut at the point of bending and the laterals were cut back to a length of approximately six inches. Practically no cane thinning was done at any time during the course of the experiment. The second spring and each spring thereafter the laterals were uniformly cut to about six inches in length.

Throughout the experiment, the fruiting canes were tied up to prevent the breaking incident to cultivation and to keep the fruit off the ground. No fertilizer of any kind was applied. Cultivation was stopped each year after the harvest season and a cover crop of oats and buckwheat was sown. Individual plant records were taken in which new shoots were counted and their diameters measured and the berries were weighed to the nearest sixteenth of an ounce.

Verticillium wilt was introduced into the Station fields in a shipment of plants in 1926 and, unfortunately, during the third year of this

experiment, it became established in the field where these investigations were being conducted. As a result, the number of plants was considerably reduced from that with which the experiment started. However, records were used only from plants that went through the entire four years without showing signs of disease. An objection might be made that following the removal of diseased plants those that remained were unduly benefitted by the extra room that they were afforded. Observation fails to indicate, however, that those plants in outside rows or growing near vacancies showed any advantage.

Influence of Size of Tips on Number and Size of New Shoots and on Subsequent Crop Production

Data presented in Tables 1 and 2 show the influence of the weight of the tip on length of shoot growth the first year on number and size

Table 1.—Influence of weight of black raspberry tips on new shoot growth the year of planting.

Weight of Tips in sixteenths of an ounce	Number of Tips	Average Length of Main Cane (Inches)
3	5	12.0
4	5	12.0
5	6	20.1
6	9	19.5
7	7	16.7
8	13	23.5
9	6	24.6
10	12	27.6
11	7	25.6
12	5	28.6
13	2	24.0
14	7	46.1
15	7	35.3
16	16	34.5
17	7	42.3
18	5	36.6
19	3	55.0
20	4	54.0
21	6	33.1
22	11	44.2
23	1	46.0
24	4	41.2
25	1	44.0
26	2	66.5
27	3	43.3
28	1	42.0
29	3	58.3
30	3	47.3
31	2	67.0
32	3	56.0
33	5	41.4
35	1	85.0
36	1	62.0
38	3	74.7
40	1	37.0
41	1	78.0
42	1	77.0
43	2	67.5
45	2	95.5
48	1	70.0
3- 5	16	15.0
6-10	47	22.0
11-15	28	33.6
16-20	35	40.3
21-25	23	40.8
26-30	12	51.3
31-35	11	54.0
36-40	5	64.6
41-48	7	73.7

Table 2.—Influence of weight of black raspberry tips on number and diameter of fruiting canes produced the second and third fruiting seasons.

Weight of Tip 16ths of an Ounce	Number of Plants	Average Yield 1928 (Ounces)	Average Number Canes 1929	Average Diameter Canes 1929 (Inches)	Average Yield 1929 (Ounces)	Average Number Canes 1930	Average Diameter Canes 1930 (Inches)	Average Yield 1930 (Ounces)	Average Yield 3-years (Ounces)
3- 5	8	24 4	4 62	425	26 18	4 00	425	20 75	23 7
6-10	22	27 6	4 59	468	35 31	5 36	428	34 0	32 4
11-15	15	36 4	5 80	450	31 56	5 40	403	27 41	31 7
16-20	18	31 4	6 18	422	31 18	6 11	.425	32 25	31 5
21-25	12	31 6	5 00	418	25 81	6 08	400	27 50	28 4
26-38	12	33 4	5 41	.450	31 41	5 75	412	30 87	31 5

of shoots in later years and on berry production. They show that the length of the shoots the season following planting was greater as the weight of tips increased.

However, neither the number of shoots per crown nor the average diameter of shoots seem to have been materially influenced in later years by size of tip used for propagation purposes (Table 2). Furthermore, a study of this same table shows that there is little, if any, correlation between size and number of shoots or canes per hill. That is, the few-caned hill is just as likely but no more likely to have large canes than the many-caned hill and neither few canes nor large canes can be insured by the use of especially large tips at the time of setting.

Apparently, the weight of the tip is relatively unimportant in determining subsequent yields of the plant, except possibly in the case of tips weighing from three to five-sixteenths ounces (Table 2). Such tips, however, are so small that ordinarily they would be discarded as culls by the nurseryman. The figures in Table 1 might suggest that the differences in growth observed the first year would naturally be followed by greater differences in production the succeeding year. It is probable that the pruning given the plants during the second spring acted as a levelling influence, tending to reduce all the plants to the point where they possessed about the same amount of bearing area. They were given the ordinary commercial pruning, however. It is possible that, had no pruning been given, the increased growth from the larger tips the first season might have resulted in somewhat larger yields the following summer. It may with equal justification be assumed that an overloaded condition would have resulted from no pruning or very light pruning which, in turn, might have resulted in no actual increase in total yield and only the production of a larger number of small berries.

The yields for the first year, as shown in Table 2, are about the same as those for the second and third year. This is unusual, as the first crop from black raspberry plants is ordinarily considerably smaller than subsequent crops. This exception was due to unusually favorable growing conditions in 1928. Showers were frequent, especially just before and during the picking season.

Relation Between Yield of Parent Plants and that of Plants Propagated from Them

When the growth records and yields of the progeny of individual plants were grouped according to those of the parents, the figures indicate that practically no benefit was derived by propagating from high producing plants (Table 3). Apparently in propagating the black raspberry, it is necessary only to layer tips of plants that are healthy, regardless of their size and productivity.

Table 3.—The influence of high and low producing plants on the number of canes produced by plants propagated from them and on the yield of the daughter plants

Yield of Parent Plants in Ounces—3-Year Average	Number of Progeny	Average Number of Canes Produced by Progeny in 1929	Average Number of Canes Produced by Progeny in 1930	Average Yield of Progeny in Ounces 3-Year Average
14-20	18	5 6	5 3	31 4
21-29	18	5 4	5 4	30 5
32-40	20	4 6	5 6	26 4
41-52	15	4 9	5 8	35 4
14-29	36	5 5	5 3	30 9
32-52	45	4 7	5 7	30 9

Relation of Number of Canes per Plant to Yield

It has been stated that in pruning the plants in this experiment very little cane thinning was done, only canes smaller than a common lead pencil were removed. The laterals were all pruned to approximately six inches in length. Yield records are grouped in Table 4 according to the number of canes to the hill. It is evident that production increased in direct proportion to the number of canes in the hill.

Table 5.—The relation of the number of canes per plant to total yield. 1929 and 1930.

Number of Canes Per Plant	Number of Plants	Average Yield in Ounces (1929)	Average Yield in Ounces (1930)
2	12	17 5	16.2
3	16	24 2	20 5
4	25	26 4	25 8
5	33	27 9	27 1
6	20	36 2	32.9
7	20	33 9	29 2
8	4	47.8	36.2
9	5	49 8	42 8
10	4	40 2	40.5

Discussion

Some of the least productive of the parent plants were low yielders because they possessed only one or two fruiting canes. It is significant that their daughter plants did not show any marked tendency in this direction, nor did the daughters of the heavy yielding plants show any

marked tendency to produce daughters with more than the average number of canes. Earlier investigations have shown that the best fruiting wood of the black raspberry is found on the main cane and on the basal section of its laterals and that light pruning back of the laterals of a few-caned hill does not enable the hill materially to surpass the yield of a rather severely pruned hill of the same cane number.

It is obvious, therefore, that in propagating the black raspberry there is no occasion for special selection of extra-productive parent plants or of extra large tips (provided the parent plant is healthy) and that comparatively little cane thinning should be done in pruning.

EFFECTS OF HARDENING CHRYSANTHEMUM PLANTS[1]

Tests of Six Varieties Show Little Difference in Flowers of Two Classes

G W WOODBURY, SECTION OF HORTICULTURE

During the past two or three decades, the greenhouse chrysanthemum has been developed extensively until today it offers possibilities to the florist and amateur gardener which few other herbaceous plants possess. Its wide range of color and form, together with the ease with which it adapts itself to varying and sometimes adverse conditions, make it a great favorite during the autumn and early winter months.

Though the culture of chrysanthemums, in general, is not difficult, the grower's neglect often results in the production of small inferior blossoms for which there is little market demand. Owing to the rush of other work during the spring months, chrysanthemum plants are very likely to be more or less neglected between the cutting-bed and benching stages, the result being a more or less hardened condition at the time of planting. Lack of moisture, too low temperature, lack of feeding, and becoming pot bound are the more important factors that bring about such a condition. Among vegetable growers, hardening is commonly employed to fit the plant better to stand the transplanting process. Chrysanthemum plants, however, are rarely, if ever, hardened intentionally. The ultimate effects of hardening of chrysanthemums have not been clearly established by experimental work, but it has been the consensus of opinion, among commercial growers at least, that hardening, being caused by a check in growth, is not easily overcome by a plant growing under ordinary greenhouse conditions. Furthermore, growers believe that hardening is not conducive to the production of first quality blooms on stems with good foliage.

To study the effects of the hardening of chrysanthemums and to de-

[1]Condensed from a thesis submitted to the Graduate Faculty of Michigan State College in partial fulfillment of the requirements for the M. S. degree.

termine the value of different methods for reducing them to a minimum, an experiment was carried out in the greenhouse at Michigan State College under conditions similar to those found in commercial establishments. Six mid-season varieties that represent a blooming period of about one month, were chosen for the test. These varieties were Yellow Rager, Pink Chieftain, Gladys Pearson, Dr. Enguehard, Nellie

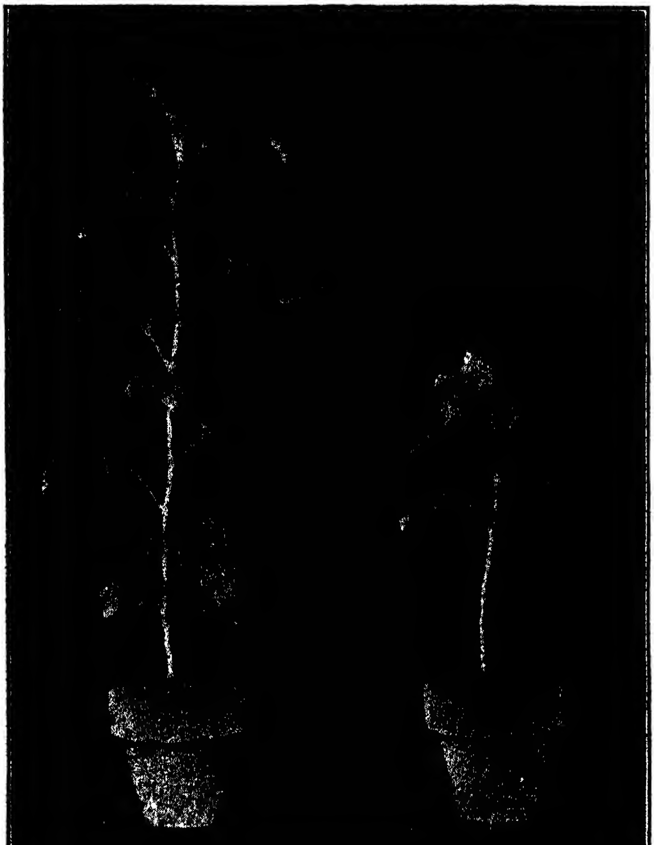


Fig. 1.—Plants of variety Major Bonnaffon at benching time. Hardened plant at the right and unhardened plant at the left.

T. Ross, and Major Bonnaffon. Plants were grown from cuttings taken during the early part of April. They were good size and in excellent condition by June 1. At that time, one-half of each variety were hardened, principally by withholding water. Only small amounts of water were given them and then only after they had become somewhat wilted. The remaining plants of each variety were well cared for and kept in as good condition as possible. By the time of benching,

June 24, a marked difference was evident between the two lots (Fig. 1). Besides a difference in size, there was also a difference in appearance; the hard plants had lost some of their lower leaves and become woody at the base. Their leaves had a yellowish tinge.

At the time of benching, the plants were so arranged that four hardened and four unhardened plants of each of the six varieties were subjected to each of the following 12 cultural treatments:

1. One pound of 2-16-2 commercial fertilizer mixed thoroughly into the compost at benching time, followed by a one inch mulch of German peat one week later.
2. One pound bone meal worked into the compost at benching time, with a one inch mulch of barnyard manure applied one week after benching.
3. One pound 2-16-2 commercial fertilizer worked into the compost at benching time. In this plot, the hard plants were notched with a sharp knife at a point above the hardest portion of the plant.
4. One pound of "Vigoro" was incorporated in the compost at benching time.
5. One pound 2-16-2 commercial fertilizer was worked into the compost at benching time, followed by no further treatment.
6. One-half pound of ammonium sulphate was worked into the compost at benching time, followed on July 17 by two ounces of ammonium sulphate applied in solution at the time of watering.
7. This plot contained half imported German peat and half soil by volume, mixed together. The hard plants in this plot were set deep so that the hardest portion was below the surface.
8. Half peat and half soil were used in this plot similar to above with no additional treatment.
9. No treatment was given except that the hardened plants were injured as in plot 3.
10. No soil treatment was used, but the hardened plants were set deep as in plot 7.
11. All plants in this plot were pinched back two or three nodes one week following the benching.
12. No treatment was given either soil or plants in this plot.

Each plot covered an area of 20 square feet. By using such an arrangement of the two treatments in the twelve plots, it was possible to check the soft plants againt the hard plants in each plot, and to check each plot against any one or all of the others.

Experimental Results

Records were obtained on date of maturity of flower, size of flower, length of stem, and general quality of the flower. Growth measurements were made once each week during the growing season. This made possible a study of rate and amount of growth in both the hard and soft plants. Length of stem is not a factor of major importance unless the stems are so short as to make the blooms unsaleable. Experimental data from previous experiments show that there is little correlation between length of stem and size of bloom. Any stem from

30 to 36 inches long is satisfactory. Beyond that, greater length possesses little commercial value.

Size and quality of blooms is important, but ordinarily flower buyers are not critical regarding variations in diameter of a fraction of an inch, though for exhibition purposes the situation is different. The accompanying table shows the average height of all hard and soft plants in each plot regardless of variety. A study of the figures shows that in only one plot, No. 5, in which a 2-16-2 fertilizer was used alone at the beginning of the experiment, did the hard plants equal or exceed the soft plants in height. In all plots, the stems were long enough to meet ordinary requirements. Differences in stem length were most apparent in the earlier varieties. Nellie T. Ross, the last variety to bloom, showed no difference either in date of maturity or length of stem.

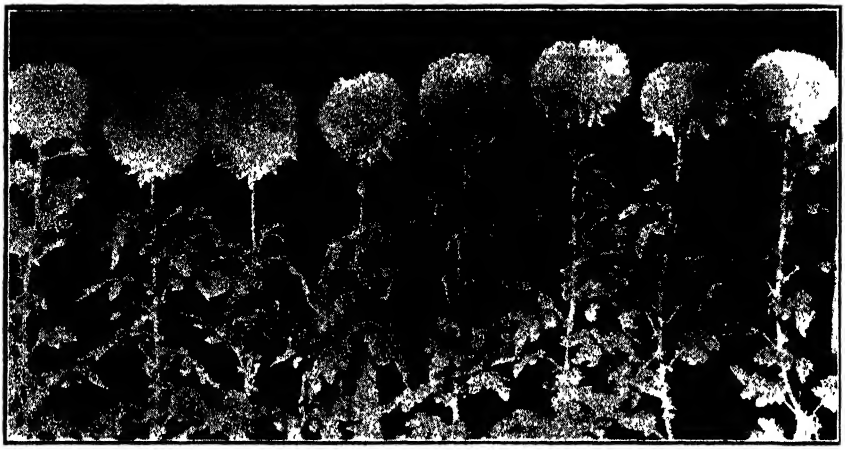


Fig. 2.—Bloom of variety Nellie T. Ross. Unhardened plants appear at the right and hardened plants at the left. Stems were cut off to facilitate photographing. These blooms taken from plot 8.

The blooms from the soft plants, in all except the pinched plot, were slightly larger than those from the hard plants. These differences, however, are small and would not be readily observed by the purchaser of chrysanthemums. In size of bloom, as in length of stem and date of maturity, the first variety to bloom, Pink Chieftain, showed the greatest difference as between hardened and unhardened plants, and the variety Nellie T. Ross showed the least. This can be accounted for by the fact that the early varieties were in a more advanced stage of development when hardening took place, thus giving them less opportunity to outgrow the effects of the hardening process.

As far as quality of stem, flower, and foliage is concerned, the hard plants could not be distinguished from the soft plants, even by the most critical observer. Observations made on the keeping qualities of the two lots brought out no difference between the blooms from the hard and soft plants. Plants in the two peat plots took on a rich

Table 1.—Records of hardened and unhardened chrysanthemum plants.

Plot Number	Average Height at Beginning of Experiment (Inches)		Average Height at End of Experiment (Inches)		Average Size of Blooms Diameter in inches	
	Soft	Hard	Soft	Hard	Soft	Hard
1	8 67	5 04	47 8	45 9	5 22	5 07
2	7 56	4 78	44 58	42 00	4 81	4 61
3	7 71	3 50	42 00	41 23	5 01	4 63
4	9 07	4 58	44 00	41 50	5 28	5 10
5	8 20	5 60	40 79	41 37	4 89	4 75
6	9 06	5 22	43 25	40 33	5 19	4 85
7	8 96	4 21	44 52	42 79	4 80	4 88
8	9 38	5 41	45 62	42 17	4 97	4 83
9	8 86	4 69	47 37	41 16	5 19	4 88
10	7 86	7 59	41 37	39 54	4 97	4 82
11	6 31	4 32	37 41	34 00	4 94	5 15
12	9 21	6 95	42 50	39 17	5 06	4 95

The above averages are taken from hard and soft plants in each plot, irrespective of variety

green color early in the season and showed better growth than was indicated in the other plots. This color, however, was less distinct as the season progressed.

Owing to the fact that only one planting date was used in this work, it is not possible to predict the outcome had the work been started at a later date. An experiment in which hardened and unhardened plants could be planted at intervals extending into July would show at what date hardening causes greatest deleterious results. Conversely, if such plants could be planted early it is safe to assume that above results could be reduced to a minimum. Differences between hardened and non-hardened plants, as brought out under the conditions of this experiment, at least, are too small to be significant.

HILL SPACING TESTS WITH POTATOES

H. C. MOORE, E. J. WHEELER, J. J. BIRD, SECTION OF FARM CROPS

That closer spacing of potatoes in the row tends to reduce losses from hollow heart, oversized, and rough potatoes, and increases the yield per acre of marketable potatoes has been brought out by trials which have been conducted by the Farm Crops section of the Michigan Experiment Station. These trials have been carried on over a period of five years on both fertilized and unfertilized soil. In some instances summer rainfall has been above normal and in others it has been markedly deficient. Yet, almost without exception, the results secured from the plots planted at the different spacing distances have pointed out the advantages of closer spacing of the seed at planting time.

The results of these trials are given in Table 1.

Table 1.—Results of spacing distance tests, 1926-1930.

Year	Locality	Number of Tests	Spacing Distances (Inches)	Yield Per Acre, Bu. U.S No. 1	Per Cent Hollow Heart	Average Rainfall for State in August (Inches)
1926	Michigan State College, East Lansing ..	3	36x18 36x36	359 267	2 65 9 35	3 43 (0.61 inches above normal)
1926.	H. Near, Oceana County . .	1	32x16 32x32	306 2 289 9	2 0 13 7	
1926	W. Greenman, Antrim County	1	34x17 34x34	384 5 351 2	7 84 30 90	
1927 .	11 Northern and Central Counties, Lower Peninsula.	14	36x18 36x36	.176 5 137 2	0.0 Trace	0 76 (2 06 inches below normal)
1928	9 Northern and Central Counties, Lower Peninsula.	13	36x18 36x36	223 0 175	1 9 10 0	3 5 (0 68 inches above normal)
1929.	6 Northern Counties, Lower Peninsula	9	36x12 36x18 36x36	212 216 0 133	0 0 Trace	1 28 (1 54 inches below normal)
1930	12 Counties, Lower Peninsula. . .	....	36x12 36x18 36x36	70 70 69 79 68 02	0 0 0	0 75 (2 07 inches below normal)

Previous work at this station[1] has indicated that seasons having a normal or above normal rainfall in August and early September favor the development of hollow heart and oversized, rough potatoes, while but little hollow heart is likely to be present in seasons of deficient rainfall.

A study of the data in Table 1 shows that in 1926 and 1928 when the average precipitation for the state in the mouth of August was above normal that closer spacing of the hills increased the yield of No. 1 potatoes in the 18 tests by an average of approximately 47 bushels per acre; furthermore, that close spacing of the hills gave an average of 3.6 per cent hollow potatoes compared with 16 per cent for the wide or check row spacing.

Hollow heart was not a factor in 1927, 1929 and 1930 as the rainfall in August of these years was considerably below normal. Close spacing, however, increased the yield by an average of approximately 40 bushels per acre for all the tests.

Results of the spacing distance tests were affected by rainfall. In 1930, with an August rainfall deficiency of 2.07 inches, the different spacings gave only slightly different yields and there was no hollow heart present in any of the plots. In the seasons 1926 and 1928 when August rainfall was above normal, the closer spacings not only gave the greater yields, the advantage ranging from 17 to 92 bushels per acre, but closer spacing also greatly reduced the percentage of hollow heart potatoes, as may be noted from the data in Table 1.

In the years 1927 to 1930 inclusive the spacing tests were run on both fertilized and unfertilized soil. In accordance with recommendations made by the Soils Department of the Michigan State College, 500 pounds per acre of 4-16-8 fertilizer were used for the fertilized areas.

[1]Quarterly Bulletin of the Michigan Experiment Station. Vol. 9, No. 4, May, 1929.

The closer spacings, that is 36" x 12", 36" x 18" and similar distances, gave the most satisfactory results on both fertilized and unfertilized plots. The fertilized plots gave increased yields of U. S. No. 1, potatoes in all cases. In 1930 this increase was small, owing to abnormally light rainfall, but in 1929 the fertilized plots produced an average yield of 48 bushels per acre more of U. S. No. 1's than the unfertilized plots, while in 1928 the advantage of the fertilized plots was 39 bushels of U. S. No. 1's per acre.

Yield and rainfall data are recorded in Table 2.

Table 2.—Yield and rainfall data—potato fertilizer tests, 1927-1928-1929-1930.

Year	Rainfall July (Inches)	Rainfall August (Inches)	Number of Tests	Average Yield Per Acre U.S No 1, Bu.	
				Unfertilized Plots	Fertilized Plots
1927	3 09	0 76	14	172	193
1928	2 67	3 50	13	210	249
1929	2 30	1 28	9	132	180
1930	1 40	0 75	13	64 39	74 62
Average of Four Years Tests			49	144 5	174

Recommendations

For better yields and for fewer off-type, oversized, hollow potatoes, close spacing of the hills 12 to 18 inches apart in the row is recommended. Planting in check rows (36" x 36") should be discouraged. For the past five years practically all of Michigan's 300 bushel club members have practiced close spacing of the hills. In 1930, nine of the eleven members spaced the hills less than 14 inches apart using approximately 22 bushels of seed per acre. The judicious use of commercial fertilizer and the more liberal use of good seed are two factors that help to increase yields and to improve the quality of Michigan's potato crop.

CENSUS SHOWS FEWER FARMS IN MICHIGAN

An Increase in the Average Size of Farms Has Not Maintained the Total Acreage in Farms

E. B. HILL, SECTION OF FARM MANAGEMENT

The last census indicated that Michigan had only 169,915 farms* on January 1, 1930. This is 11.7 per cent less than the number recorded in 1925, and 13.5 per cent less than in 1920. The losses in adjoining States from 1920 to 1930 were as follows: Ohio 14.4 per cent, Indiana, 11.2 per cent, Illinois, 9.4 per cent, and Wisconsin 3.8 per cent.

The New England and Atlantic States showed the greatest loss with average decreases from 1920 of 19.7 and 16.1 to 8.5 per cent respectively. In general the, southern, western and Pacific States had increases ranging from an average of 1.6 per cent for the west north-central states to 12.3 per cent for the Pacific States.

Nine counties in Michigan had losses in excess of 25 per cent of the 1920 number. Twenty-four counties had losses in excess of 20 per cent. In Figure 1, is shown the change in number of farms in per cent from 1920 to 1930. The upper figure gives the number of farms in each county on January 1, 1930. The major decreases have been in two different regions and result from different causes. One of these regions is in Wayne and Oakland counties where many farms have become absorbed by the expansion of cities. The other region is in the north central part of the State in localities which have the less fertile soils. In this section, the low prices of farm products combined with rather low yields and increasing costs have forced the abandonment of many farms. Under the present system of taxation and local government, it becomes increasingly difficult for those who remain in the areas where so many farms have been abandoned.

The decrease in the number of farms is not new to Michigan since the records indicate that there are now 2,429 less farms in Michigan than in 1890. From 1890 to 1910, however, the number of farms increased from 172,344 to 206,960. Since 1910, the number has decreased 17.9 per cent, with over half of the decrease occurring coming since 1925. Much of the earlier decrease was in the southern counties that were settled at an earlier date.

*A farm, for census purposes, includes all the land which is directly farmed by one person, either by his labor alone or with the assistance of members of his household or hired employees. Usually it must be three acres or more in size. However, any tract of land of less than three acres used for agricultural purposes which produced products to the value of $250 the preceding year is classed as a "farm."

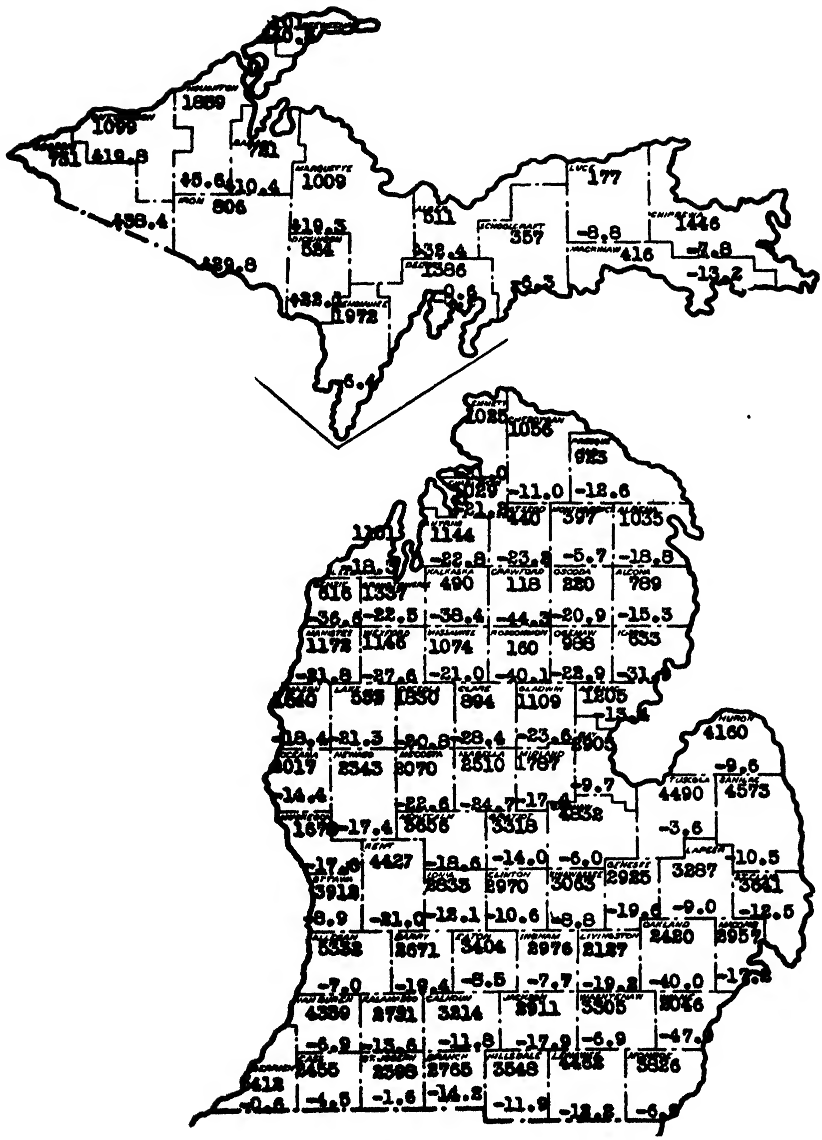


Fig. 1.—The number of farms in Michigan on January 1, 1930 is shown by the upper figures in each county. The percentage of change from 1920 is shown by the lower number.

The decrease in the number of farms in many northern counties has been in evidence mostly since 1910, as is shown in the following table.

Table 1.—The number of farms in many northern counties have been decreasing since 1910. Data for counties showing over 25 per cent loss from 1920 to 1930.

County	1890	1900	1910	1920	1925	1930
Benzie	512	949	1,245	972	809	616
Clare	414	852	1,302	1,248	1,123	894
Crawford	202	228	248	212	188	118
Iosco	496	743	958	929	715	633
Kalkaska	591	679	842	796	668	490
Roscommon	67	136	249	267	238	160
Wexford	903	1,340	1,779	1,583	1,328	1,149

The Upper Peninsula presents a somewhat different picture as nine of the 15 counties show an increase in the number of farms. The increase occurs chiefly in the western or newer sections. Decreases occur in the southern and eastern counties.

In connection with the decrease in number of farms in Michigan, the natural query is, "to what extent have farms changed in size and to what extent has there been an abandonment of land?"

These changes would vary considerably in different parts of the State and depend mostly upon soil fertility and distance from markets. Reports are now available on nine counties, of which all but Branch are in the northern portion of the Lower Peninsula. Data are presented in Table 2 to show the extent of the changes which have taken place in these sections.

Table 2.—The total land in farms, the number of farms, and the average number of acres per farm in nine counties in Michigan.

County	1910			1920			1930		
	Land in Farms	No. of Farms	Acres Per Farm	Land in Farms	No. of Farms	Acres Per Farm	Land in Farms	No. of Farms	Acres Per Farm
Alcona	104,732	884	118	131,388	932	141	116,241	789	147
Branch	306,489	3,378	91	308,805	3,222	96	289,297	2,749.	105
Crawford	46,610	248	188	50,884	212	240	36,848	115	311
Iosco	112,710	958	118	121,694	929	131	95,300	632	151
Leelanau	159,303	1,444	110	165,399	1,347	124	143,823	1,100	130
Missaukee	147,355	1,439	102	168,710	1,359	124	161,839	1,068	151
Ogemaw	144,628	1,283	113	166,463	1,281	129	149,195	985	152
Oscoda	59,924	344	174	47,724	278	172	42,202	220	192
Wexford	147,585	1,340	80	146,712	1,583	93	127,206	1,149	111
	1,229,336	11,318	109	1,307,779	11,143	117	1,161,951	8,807	132

In the nine counties, in Table 2, on which reports are now available, the amount of land in farms in 1930 was 11.3 per cent less than in 1920 and 5.5 per cent less than in 1910. The number of farms was 21 per cent and 22 per cent less respectively for 1920 and 1910. The average number of acres per farm was 109 in 1910, this was increased eight acres

by 1920 so the average farm then had 117 acres, and by 1930 the increase was 15 acres per farm making 132 acres in the average farm.

It is evident there has been some decrease in the total amount of land in all farms as well as in the number of farms. Some of the reasons for the increase in the number of acres per farm are the use of new and larger machinery and power units, the increased efficiency of the average farmer, the need for increasing the size of the farm business, and the use of more extensive types of farming and farming methods.

It is not expected, however, that the records for the entire State will show as large an increase per farm as do these nine counties. Branch county with an increase of nine acres per farm since 1920 is more typical of what might be expected for the major agricultural regions. The "family size" of farm can be expected to hold its advantage and it will not be replaced by large numbers of other types in Michigan.

The census figures for practically all of the counties discussed in this report show that farms of less than 100 acres decreased in number much faster than did other sizes since 1920. The number of farms between 100 and 174 acres show some decrease in most counties but not to the extent shown in the smaller size groups. In most every county, there was an increase in the number of farms between 175 and 259 acres. Alcona, Branch, Missaukee, Ogemaw, and Wexford counties showed an increase in the 260 to 499 acre group.

In most cases, these figures are typical of the adjustments which farmers are making to better meet the economic conditions under which they are operating. They are abandoning or pasturing the less productive and concentrating their crops on the more productive land. They are increasing the acreage of land and thus the volume of business per farm as another means of reducing production costs.

ABORTION ACCOMPANIES BRUCELLA SUIS INFECTION IN A SOW*

H. W. JOHNSON AND L. B. SHOLL, SECTION OF BACTERIOLOGY AND DEPARTMENT OF ANIMAL PATHOLOGY

During the past year, a large herd of hogs has been under observation. The herd contained a considerable number of animals which were found to be infected or had been infected with *Brucella.* Many of the hogs showed serum agglutinins for *Brucella* in high titer and, when slaughtered, *Brucella suis*[1] was recovered from their organs in culture. A close watch has been kept for the occurrence of expulsion of fetuses in the infected sows because so many have termed *Brucella* infection of swine an abortion disease.

*This project is partly financed by a grant from the National Research Council.

[1]Huddleson, I. F.—The differentiation of the species of the Genus Brucella. Annual meeting of American Public Health Association, Chicago, October, 1928.

In view of the fact that only one brood sow out of *43* showing *Brucella* agglutinins has aborted in the herd, a full report of the case was believed to have particular interest. The sow was a three year old Chester White. Her breeding record follows: On April 5, 1928, she farrowed eight living and two dead pigs. On May 22, 1929, she farrowed 10 living and three dead pigs. On September 18, 1929, she farrowed seven living and four dead pigs. Only four of the seven lived to weaning age. On March 21, 1930, she aborted six dead pigs, 10 days premature. The pigs and fetal membranes were brought to the laboratory for bacteriological and pathological study.

Five placentas were obtained. All show some small grayish foci and some areas in which the villi appear to be stripped from the membranes The first placenta to be examined shows no gross lesions except those noted above. The second shows numerous areas in which the villi are rather opaque. Near the center of this placenta is a band about five cm. wide and somewhat brownish in color extending more than half way around it. The villi in this band are opaque. The third placenta shows two areas of congestion about seven or eight cm. in diameter. An area at one tip about nine cm. long shows considerable opacity and some brownish-yellow exudate. The fourth placenta shows a band varying from six to 20 cm. wide which is yellowish-white in color, thickened, and covered with brownish-yellow exudate similar in appearance to the exudate described in infections of the bovine placenta. This band extends almost around the center of the placenta. A few similar areas of smaller size are noted. The villi throughout this placenta are quite opaque. The fifth placenta still incloses one of the fetuses. It is parboiled in appearance, friable, thickened, and very opaque.

There are four female and two male pigs. All appear about the same in gross appearance. The lungs are completely atelectatic, and in three of the pigs there is some mottled appearance suggestive of fetal pneumonia. The lymph nodes show some congestion. The livers show some mottled areas suggestive of slight fatty changes. No other gross changes are noted.

The first agglutination test on the blood serum of the hog, made January 1, 1930, showed only a trace in 1-25. February 17 and 31, 1930, the reaction was complete in 1-100. The sow was killed on March 31, 1930, 10 days after aborting. The spleen, kidneys, liver, lymph nodes, mammary glands, and reproductive organs were brought to the laboratory for bacteriological and pathological study.

About six inches of one end of the spleen is dark red and somewhat swollen. Numerous red papules about one to two mm. in diameter are present on the visceral surface. Some of the supramammary lymph nodes show peripheral congestion and possibly some hemorrhage. All other lymph nodes appear normal. One mammary gland contains four abscesses three to four cm. each in diameter and filled with foul-smelling, greenish-yellow pus. The others appear normal. The left ovary is three by two by three cm. in size and contains several cysts one to two cm. in diameter. The right ovary is four by two by three cm. in size and very cystic. The uterine mucosa is wrinkled and is dark and rather mottled in color. There is some congestion and edema.

Brucella suis was isolated from the spleen, liver, kidney, and epididymis

of a guinea pig inoculated with material taken from the fetal membranes. Pure cultures of *Br. suis* were obtained from the lungs, liver, spleen, and kidney of each of the aborted pigs. *Br. suis* was isolated from the spleen and from the supramammary and submaxillary lymph nodes of the sow at the time she was killed.

Histologically, the fetal membranes are markedly thickened due to edema and cellular infiltration. There is abundant exudate on the surface in many places. The villi show much necrosis, and a large number of the have been stripped off. Large areas of all sections show marked cellular infiltration, the cells consisting of polymorphs, reticulo-endothelial cells, and lymphocytes. This cellular infiltration appears especially marked around some of the larger blood vessels. Some of the large arteries appear somewhat sclerotic.

In sections of the lungs of two of the fetuses, some broncho-pneumonia is noted. These are the only definite lesions noted in the organs of the fetuses. All show some postmorten decomposition. Histologically, sections from two lymph nodes of the sow show congestion, some hemorrhage, and a few foci of polymorphonuclear cell infiltration. The uterus is congested, somewhat edematous, and contains a few small hemorrhages under the mucosa. Several small foci of reticulo-endothelial cell and lymphocytic infiltration are noted under the mucosa and around some of the blood vessels and uterine glands, and one focus is 270 microns in diameter. Sections from the mammary glands reveal some exudative mastitis and a few foci of interstitial cellular infiltration. Some abscess formation is noted in two of the sections, and there is some fibrosis present. The spleen is engorged with blood.

It is interesting to note that the lesions just described are very similar in nature to those occurring in the reproductive organs of cows infected with *Br. abortus*. Although we have examined the placentas and reproductive organs from many sows, not another one has shown the marked lesions in both the placentas and uterus such as were seen in this sow.

The only other report of histopathological studies of *Brucella* infected sows and fetuses from such sows, which we have been able to find in the literature are those made by Smith[2]. His findings were essentially negative in so far as histological changes were concerned.

[2]Smith, T.—A strain of Bacillus abortus from swine. Journal of Experimental Medicine, 49:671-679, April '29.

CHATHAM STATION COMPARES SILAGE CROPS

Sunflowers Outyield Artichokes and are Ready for Harvest Earlier In Upper Peninsula Tests

B. R. CHURCHILL, SECTION OF FARM CROPS

That the Jerusalem artichoke cannot compete with sunflowers or root crops as a producer of succulent feed for livestock under conditions prevailing throughout most of the Upper Peninsula of Michigan, is indicated by experiments carried on at Chatham, Michigan, during the seasons of 1929 and 1930. The actual yields of sunflowers, Jerusalem artichokes, and rutabagas secured in these experiments are reported in Table 1.

Table 1.—Yields of sunflowers, artichoke tops, artichoke tubers and rutabagas at the Upper Peninsula Experiment Station, 1929-1930.

Crop	Yield in Tons Per Acre		
	1929	1930	Average
Sunflower tops	16 90	15 25	16 08
Artichoke tops	12.10	7.76	9 93
Artichoke tubers, tops removed	6 50	4 22	5 36
Artichoke tubers, tops not removed	8 78	7 31	8 05
Rutabagas	15 00	21 20	18 10

Sunflowers averaged 6.15 tons per acre more than Jerusalem artichokes for silage and averaged more than three-fourths of a ton higher than the artichoke silage and roots combined. The fact that sunflowers outyielded the Jerusalem artichoke is not, however, their only advantage. Although the two crops were planted at the same time in 1929 and 1930, the artichokes were not in condition to make good silage when the sunflowers were ready for harvest. The artichokes were allowed to grow until severe frosts threatened, and even then they had not bloomed. Had the artichokes been harvested at the same time as the sunflowers, their yield would have been even lower. Figure 1 shows the comparative growth of the two crops in 1930 at the time the sunflowers were ready for the silo.

Sunflowers have been used for silage at the Upper Peninsula Experiment Station for several years. Sunflower silage, according to Henry and Morrison, has an analysis very similar to that of immature

corn and about 72 per cent equal to mature corn silage based on total digestible nutrients. At the Upper Peninsula Experiment Station, Chatham, Michigan, the actual feeding value of the sunflower silage is considered slightly superior to immature corn silage and from 75 to 90 per cent equal to mature corn silage depending upon the condition of the sunflowers when cut. Late cutting is not advisable since the stems of the sunflowers become more woody as the crop approaches maturity. General recommendations are to cut sunflowers for silage when one-tenth to one-half of the plants are in bloom.

At the Upper Peninsula Experiment Station, five to eight tons of corn silage would be considered a good acre yield, while sunflowers

Fig. 1.—Comparative growth of sunflowers and Jerusalem artichokes at the Upper Peninsula Experiment Station, 1930. Sunflowers on the left and in the background, artichokes on the right. Both crops were planted on June 9. Sunflowers were cut on September 12, artichokes on September 26.

have averaged more than 15 tons per acre for several years. Corn has been grown at this station in three of the last five years and it did not mature in any of the three years. This is the general experience throughout most of the Upper Peninsula, so, for this part of the State, sunflowers must be compared with immature corn. Under the conditions prevailing at Chatham, sunflowers would produce over three-fourths of a ton more total digestible nutrients per acre than corn. Sunflowers do not require as long a growing season as does corn and they are less subject to injury from frost in the fall.

The Jerusalem artichoke is a plant with a top growth very similar to that of the sunflower. Since the artichoke produces tubers as well as a top growth, the yields of the tubers were taken in these experiments. To determine the effect of removing the artichoke tops for silage upon the yields of the tubers, a number of plots were harvested

for tuber yield without removing the tops. In these experiments, both sunflowers and artichokes were planted in rows three feet apart and 40 feet long. The sunflowers were seeded at the field seeding rate of 10 pounds per acre, while the artichoke tubers were planted 18 inches apart in the row.

The artichoke tubers averaged 5.36 tons per acre where the tops were removed for silage and 8.05 tons per acre where the tops were not removed, which showed that cutting the tops of the Jerusalem artichoke plants when they are in best condition for silage purposes materially reduces the yield of tubers. In these experiments, the tuber yield was reduced 33.4 per cent by this practice. In comparison to the above given yields of artichoke tubers, purple top rutabagas, grown in these experiments, produced an average yield of 18.1 tons per acre for the two years. This is an increase of 124.8 per cent over the yield of the artichoke tubers even where the tops were not removed. It may be noted here that in 1929 the rutabaga yield was from a second planting. The first planting gave a very poor stand due to unfavorable conditions. The relative feeding value of the various crops used in these experiments is given in Table 2.

Table 2.—Analysis of Upper Peninsula silage and root crops.[2]

Crop	Total Dry Matter in 100 Lbs.	Digestible Nutrients in 100 Lbs.				Nutritive Ratio 1.
		Crude Protein	Carbo-hydrates	Fat	Total	
Mature corn silage	26.3	1.1	15.0	0.7	17.7	15.1
Immature corn silage	21.0	1.0	11.4	0.4	13.3	12.3
Sunflower silage	21.9	1.0	9.8	0.8	12.6	11.6
Artichoke tubers	20.5	1.0	14.6	0.1	15.8	14.8
Mangels	9.4	0.8	6.4	0.1	7.4	8.2
Rutabagas	10.9	1.0	7.7	0.3	9.4	8.4
Potatoes	21.2	1.1	15.8	0.1	17.1	14.5

(2) Feeds and Feeding, by Henry and Morrison.

Jerusalem artichoke tubers show an analysis very similar to that of potatoes. Both potatoes and artichokes are higher in total dry matter, carbohydrates, and total digestible nutrients than mangels or rutabagas. When considered on an acre basis, however, the rutabagas yielded, for the two-year period, 859 pounds more total digestible nutrients each year than did artichoke tubers.

Another serious disadvantage of the Jerusalem artichoke is the ability of the tubers to produce plants after being in the ground throughout the winter. Small pieces of artichoke tubers are capable of producing new plants and it is difficult to rid a field of the crop once it has been grown there. Thus, the artichoke may become a pest.

Conclusions

Field experience has shown that sunflowers, for silage, are more dependable than corn in most sections of the Upper Peninsula of Michigan. The difference in yield in favor of the sunflowers more than makes up for their slightly lower feeding value.

Experiments at the Upper Peninsula Station indicate that the Jerusalem artichoke cannot compete with sunflowers as a silage crop nor with the purple top rutabaga as a root crop in the Upper Peninsula.

DRY COTTON DISCS ARE MOST EFFICIENT MILK STRAINERS

Wire Gauze Has Been Discredited As a Material For Removing Foreign Material from Milk

G. MALCOLM TROUT, SECTION OF DAIRY HUSBANDRY

Despite all precautions to exclude foreign materials from milk, an appreciable amount of sediment finds its way into the milk supply during milking and subsequent handling. The presence of this sediment makes straining of the milk before sending to market an imperative operation. During certain months of the year, tests are made at many market milk plants to determine the amount of sediment present in the milk purchased. The results of these tests, when compared to standard charts, give a definite idea concerning the cleanliness of milk production and also a numerical rating which affects the final total score of the milk examined.

Because of its inefficiency, its source of contamination, and its condemnation by city milk ordinances and milk inspectors, the wire gauze strainer has been relegated to the past in Michigan market milk circles. In its place, various kinds of cloth and cotton pad strainers are being used. During the past winter, several trials were made at this station to determine the comparative values of several types of strainer materials. Eight different kinds of strainer cloth materials and cotton pads were used. Eight of these were used in the standard stamped milk strainer, which consists of the strainer proper, the concave perforated disc and the securing ring. The strainer materials consisted of two different makes of common cotton discs, one gauze-face reinforced cotton disc, squares of flannel, percale, doubled cheese cloth, muslin with the fibre side up, and muslin with the fibre side down.

Three gallons of whole raw milk to which were added exactly five grams of very finely pulverized dirt, were strained through each type of strainer at temperatures of 95°, 80°, and 60° F. In one series, all the strainers were wet with water before admitting the milk, while, in a second series, all the strainers were dry. The efficiency of the strainer in removing the dirt is shown in Fig. 1. The sediment discs show the amount of the dirt per pint which passed through the dry filter when the milk was at a temperature of 95° F. At this temperature, the milk passed through the strainers, whether wet or dry, very rapidly. However, at 80° F., the time required for the milk to pass through the

strainers previously wetted with water was considerably longer than that required for a similar lot to pass through the dry strainers. Different periods of time were required for the milk to flow through the different wetted strainers depending upon the thickness and nature of the material. When the strainer was previously wetted, the water which first came in contact with the strainer seemed to dominate the strainer and let the milk, which is an emulsion of fat and water, flow through with difficulty. Furthermore, the wetted strainer was much less efficient in removing the sediment from the milk.

The flow of milk through the strainers at 60° F. was so slow that it would be impractical to attempt to strain milk at that temperature.

The meshes of the cheese cloth were so large that practically all the sediment passed through without difficulty even when the cloth was doubled. One thickness of percale used as a strainer could easily be classed with cheese cloth in respect to rapidity and efficiency.

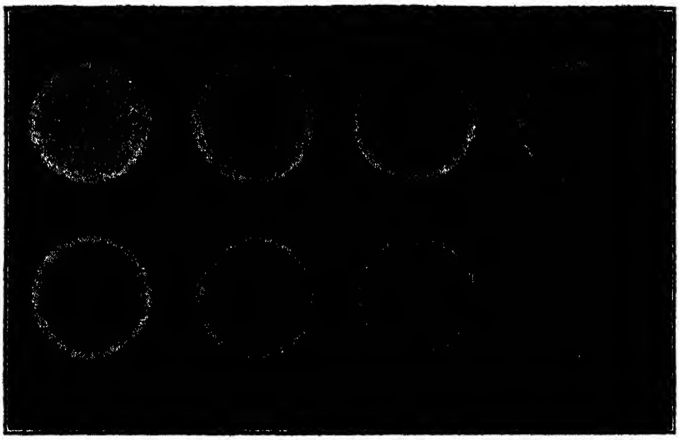


Fig. 1.—Sediment discs showing the efficiency of eight types of strainers in removing sediment from milk. Each disc represents the sediment contained in one pint of milk which had flown through one type of strainer. Note the efficiency of strainer No. 1 and also of 2, 7, and 8.

Muslin, either with the fibre side next to the milk or opposite was little better than cheese cloth or percale in removing the sediment from milk. However, when used with the fibre side next to the milk, more efficient straining resulted than when the strainer cloth was reversed.

Of the various cloths used, flannel was most efficient in removing dirt from the milk, although the efficiency could not be compared with that obtained by use of the various cotton pad strainers.

Three different kinds of cotton strainer pads were used. Each was very efficient and rapid in removing the dirt from the milk, especially when not more than 10 to 15 gallons of milk were strained through the same pad.

A second series of experiments consisted of straining 40 gallons of milk at 95° F. through each of the three cotton strainer pads and

through the most efficient cloth, flannel. A sediment test was taken of the original milk and again after each 10 gallon portion had passed through the strainer. The sediment discs secured are shown in Figure 2. In general, the flow was considerably decreased after the first 10 gallons had passed through the strainer. Often, it was necessary to administer a slight jar at the beginning or soon following the intro-

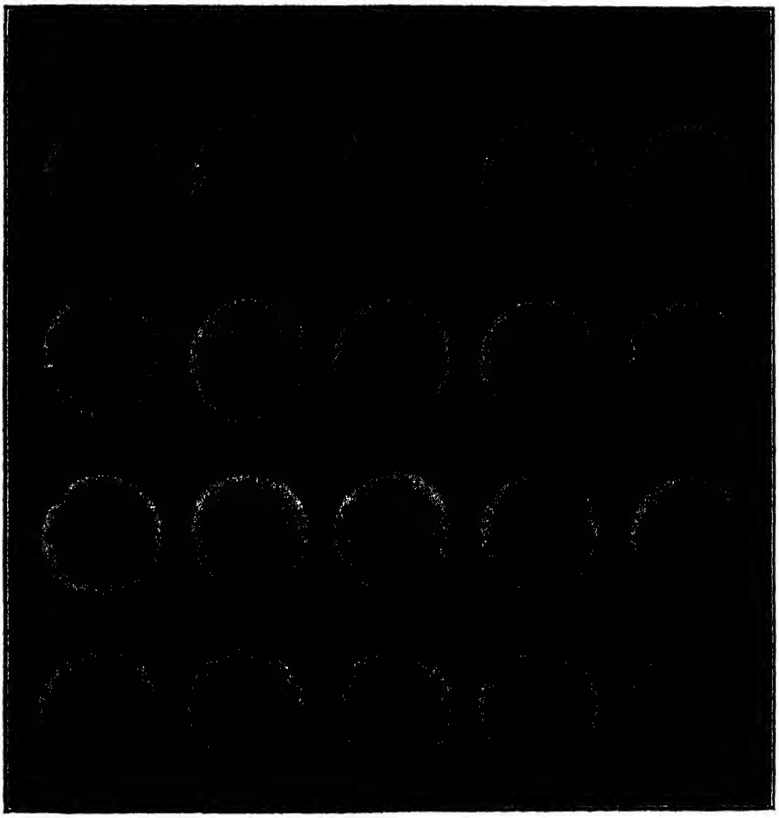


Fig. 2.—Sediment discs showing the efficiency of four different types of strainer pads after 10, 20, 30, and 40 gallons of milk had been strained. Note that, after 20 gallons of milk had been strained, the efficiency of the strainer was reduced and the milk contained approximately as much sediment as the original milk before it was strained. The numbers under the discs indicate the scores.

duction of the second 10 gallon portion. The tests showed that in every case, jarring was unsatisfactory as it reduced the efficiency of the strainer. The last 10 gallon portion yielded a sediment disc showing as much sediment as the sediment disc of the original milk before straining. Jarring seemed to make small holes in the strainer pads which resulted in uneven straining and through which the previously collected dirt passed readily.

Time is an important factor in straining milk. When not more than 10 gallons of milk were strained through each strainer pad, the difference in time required with the different strainer pads was of little practical importance. In every case, considerably more time was required to strain the second 10 gallon portion. In some cases, the time required to strain the second 10 gallon portion was over twice that required to strain the first 10 gallon portion.

In strainer pad number one, the flow of milk stopped after 18 gallons had passed through. It was necessary to give the strainer a slight jar to start the flow again. Other jars were administered after 20, 25, and 28 gallons of milk had gone through. From that point on, continuous agitation was necessary to get milk through the pad.

Similar experiences were encountered in strainer pad number two. Milk ceased flowing after 15 gallons had flown through. Jarring the strainer was necessary at that period as well as after 18, 22, 25, and 27 gallons had been strained. Continuous jarring was necessary from that period to start and maintain the milk flow through the strainer.

Strainer pad number three required less jarring. Flow of milk first ceased when 26 gallons of milk had been strained through the pad. After 30 gallons had been strained, continuous jarring was required.

Strainer pad number four permitted the milk to flow through without much jarring of the strainer. Although the flow had not ceased, a vigorous jar was given the strainer after 10 gallons had passed through. Further jarring was not necessary. The fibres seemed to break apart which permitted steady, rapid flow.

BULLETIN REVIEWS

Circ. Bul. 135.—CHESTNUT BLIGHT IN MICHIGAN.—Baxter, D. V. and Strong, F. C.—Chestnut blight caused by the fungus *Endothia parasitica* was first discovered in Michigan in 1916 on Paragon nursery stock shipped into this state. This outbreak was at once destroyed. No further signs of the disease were found until 1927 when the writers found it in southeastern Michigan on chestnut trees which had been planted at least forty years. It has since been found on native and old plantings of chestnut in eight counties, for the most part located in the southeast portion of the state. Symptoms of the disease are described. Prompt pruning out of diseased branches and the removal of cankered areas on the larger branches by surgical methods are the only ways of checking this disease known today. (18 pages, 8 plates.)

Sp. Bul. 206.—TYPES OF FARMING IN MICHIGAN.—Hill, E. B., Riddell, F. T., and Elliott, F. F.—This bulletin is intended to provide a background of information essential to a clearer understanding of the prevailing organization of the farms, the location of the different type of farming areas, and the factors influencing each of these. Because of variation in soil type, topography, climate, and economic conditions, Michigan farmers have found it advantageous to follow types of farming which may vary widely within rather short distances. An under-

standing of the nature and extent of these variations is essential before research and extension agencies can properly appraise the difficulties and needs of farmers in local areas, or before recommendations of a specific nature can be made with any reasonable degree of assurance of their applicability.

Illustrations are also given to show how the typical farming systems discussed in the bulletin may be used in conjunction with production and price information in testing out and appraising the profitableness of different types of farms. Long time and year to year adjustments in different farming systems may also be tested. In this study, the State is divided into 14 different type-of-farming areas.

The table of contents contains the following major headings: factors determining the crop and livestock enterprises, land utilization in Michigan, distribution of the important crops, crop yields in the different type-of-farming areas, distribution of livestock, size of farms, methods of outlining type of farming areas, typical farming systems in the different type of farming areas, and ways in which the typical farming systems may be used in working out farm programs and in applying agricultural outlook information. (83 pages, 28 figures, 28 tables.)

Sp. Bul. 207.—PUBLIC HEALTH AND EDUCATIONAL SERVICES IN MICHIGAN.—Hoffer, C. R.—Certain services contributing to a modern standard of living are considered in this bulletin, data being presented on the number of people necessary for each service, its present distribution, and its availability in each county of the state. Data and discussion are presented for physicians, dentists, hospitals, public health nurses, libraries, schools, and trade centers. The results indicate that about 1,000 people are necessary to support a physician, and 2,500 for a dentist. Thirty-two counties in the state have less than 500 inhabitants per hospital bed. Less than half of the counties in Michigan had county public health nurses when the data were collected (1928), but the results secured in counties having a nurse employed indicate that an expenditure for this service would be advisable. In many counties, the advantages of a public library are very meager or are absent entirely in a few instances. The data pertaining to schools suggest that density of population, value of taxable property, and the presence or absence of high schools in a county have an important influence on educational advantages. One-room school buildings far exceed those of other types and some calculations show that in sparsely populated areas consolidation is not feasible unless the density of the population is increased or provision is made by improved roads and school busses to transport pupils a considerable distance. The data show that it is sometimes necessary for two or more towns to cooperate in making certain services available. (34 pages, 6 figures, 13 tables.)

Sp. Bul. 208.—SERVICES OF INSTITUTIONS AND ORGANIZATIONS IN TOWN-COUNTRY COMMUNITIES.—Hoffer, C. R. and Cawood, M.—This bulletin presents a detailed analysis of records for 12,860 meetings held in 10 town-country communities, with a total accumulated attendance of 826,145. Churches secured the highest total attendance; schools ranked second in attendance, when regular sessions were omitted. Group activities constituted an important part of the pro-

grams. The size of the community was not especially important in determining the proportion of the population taking a part in programs. Other circumstances, such as the number of meetings held, the availability of talent, and the efforts institutions and organizations make to use it, are largely determinative in this respect. Non-residents participated only about one-third as frequently as residents and represented a wide variety of organizations. Country residents constituted 33.7 per cent of the total accumulated attendance. In these 10 communities, churches had an attendance from the country in proportion to their country membership, but lodges, study clubs, College Extension Service, patriotic, civic and school organizations had less. Country residents did not appear in programs in proportion to the total country population of the ten communities, but on the basis of membership their participation exceeded that of town members. After a sufficient population base is provided these services depend upon social influences in a community such as leadership, custom, tradition, and the kind of programs given. The services of the church and school and their auxiliary organizations are of primary importance in community development. In town-country communities more specialized organizations are necessary only when these institutions do not meet or cannot meet some evident need which exists. (37 pages, 14 tables.)

Sp. Bul. 209.—CONSUMER DEMAND FOR APPLES IN MICHIGAN.—Gaston, H. P.—The object of the study reported in this bulletin was to obtain a knowledge of consumer demand which would be of value in developing a more efficient production and marketing program for the Michigan apples. There is reported the requirements imposed by produce dealers, retailers, hotels, restaurants, and pie factories. These facts regarding demand are presented against a background of statistics relative to the source and nature of Michigan's apple supply and the disposition of her own crop. It is pointed out that the Michigan apple as now grown and packed does not fulfill all consumer requirements. In conclusion, several things which would help Michigan producers to better meet the demands of the apple market are listed and discussed. (50 pages, 13 figures, 6 tables.)

Sp. Bul. 210.—CORN GROWING IN MICHIGAN.—Rather, H. C., and Duncan, J. R.—Corn growing practices adapted to Michigan conditions are discussed in this bulletin. Varietal recommendations for both grain and silage production are given for the various corn growing regions of the state. Other discussions deal with corn judging, seed selection, drying, and testing; seed corn treatments; crow and rodent repellents; planting, cultivation, harvesting, and storage. Recommendations of the Soils Section as to fertilizers for corn are included. There is also a discussion of sunflowers for silage and of soy beans with corn for silage. (35 pages, 15 figures, 5 tables.)

Sp. Bul. 211.—A COMPARISON OF ALFALFA STRAINS AND SEED SOURCES FOR MICHIGAN.—Megee, C. R.—The experiments reported were conducted for a period of eight years and show that the Hardigan and Grimm are the most dependable variegated strains for Michigan; LaBeau, Michigan Common, Montana Common, Utah Common, Idaho Common and Dakota Common are among the better of the

common alfalfa strains. Seed from Arizona, South Africa and Argentina did not prove sufficiently satisfactory to warrant their use in Michigan.

Sp. Bul. 212.—SCHOOL FINANCING IN MICHIGAN—A PLAN TO EQUALIZE THE BURDEN.—Thrun, F. M.—This study presents and discusses a plan for bringing about tax relief in the overburdened local school districts of the state through equalizing the State's minimum educational program. Tables are presented showing the inequity of the present method of distributing state aids as well as tables demonstrating the proposed equalization plan. (78 pages, 13 tables.)

Sp. Bul. 213.—INVESTIGATIONS WITH OAT VARIETIES AND DISEASES IN THE UPPER PENINSULA.—Churchill, B. R.—This bulletin presents the results of experimental work on oats conducted at the Upper Peninsula Experiment Station, Chatham, Michigan, for the years 1919-1930, inclusive. This included yield tests of several oat varieties, seed treatment with chemicals to control smut, and the effect of date of planting of early and medium maturing oat varieties on yield. It reports the results of a study of oat varietal resistance to stem rust, carried on co-operatively with the United States Department of Agriculture. The bulletin points out the advantages of an early maturing, stem-rust resistant variety for the Upper Peninsula of Michigan. (15 pages, 3 figures, 7 tables.)

Tech. Bul. 109.—STUDIES ON BACTERIOPHAGE IN RELATION TO SALMONELLA AND PULLORUM DISEASE.—Mallmann, W. L. —Several bacteriophages were prepared for *Salmonella pullorum*, both by adaptation from a strain lytic for Shigella dysenteriae and by isolation from chicken feces. These bacteriophages, when injected into *Salmonella pullorum* infected hens, did not cause recovery. *Salmonella pullorum* was isolated in all cases at autopsy. In naturally or artificially infected chicks, the bacteriophage had no therapeutic value. Chicks were treated with bacteriophage and later exposed to *Salmonella pullorum* infection. No beneficial results were obtained. Bacteriophage and susceptible *Salmonella pullorum* cultures were isolated from the same tissues of the chicks examined. Small doses of bacteriophage had no beneficial effect while large doses caused an increased susceptibility. Bacteriophage had no prophylactic or therapeutic effect in pullorum disease of chicks or adult stock. (15 pages, 5 tables.)

Tech. Bul. 110.—A CONTRIBUTION TO THE BACTERIOLOGY AND PATHOLOGY OF THE BOVINE UDDER.—Sholl, L. B. and Torrey, J. P.—A brief review of the literature is given, and the structure of the mammary gland is reviewed. The authors present their findings on 92 cases, most of them with known histories, studied bacteriologically and histologically. As the result of this study, the authors classify the changes in the udders into the four following groups: Interstitial mastitis, exudative mastitis, suppurative mastitis, and fibrosis. The four types of changes are illustrated. Historical facts and bacteriological and histopathological findings are recorded and the results summarized. (31 pages, 5 figures, 4 tables.)

Tech. Bul. 111.—BLACK RASPBERRY STUDIES.—Marshall, R. E.

I. Some studies of Expressed Tissue Fluids.

The depression of the freezing point for expressed tissue fluids of leaves of fruiting canes was materially greater than that for the leaves of shoots of the current season's growth just previous to and throughout the harvest period for the black raspberry. The freezing point depressions of expressed fluids of leaves of both fruiting canes and current season shoots increased with advance of the growing season, but the rate of increase for the former was approximately twice as great as for the latter. On the basis of the concentration of tissue fluids, the leaves of the fruiting canes should be in a better position to obtain water near the end of the fruiting season than earlier. The apparent lack of vigor of fruiting canes in mid-summer cannot be accounted for by differences in osmotic concentration.

II. Rate of Water Movement Through Excised Parts of Fruiting Canes and Current Season Shoots.

Rates of water transmission under pressure through excised portions of Cumberland raspberry fruiting canes and current season shoots showed the rate for the canes at the end of the picking season to be approximately half that for a period immediately following blossoming while the rate for the shoots increased during this six-week period. The differences between season trends in rates of water transmission for plants subjected to different pruning treatments were not significant. It cannot be stated, on the basis of data presented, that yellowing and drying up of foliage and failure on the part of the berries properly to size up and mature during the latter part of the picking season is associated with any deficiency in the water supply.

III. Growth and Yield as Influenced by Fertilizers.

Neither the materials used nor the time of application had any material effect on yields or size of fruits though there were very marked differences in color of foliage produced by the different treatments. Plants fertilized with nitrogen just after harvest, early in September, or in early spring produced significantly heavier early season yields than other treatments. The largest berries were produced two to four days after the initiation of the harvest season, following which there was a material and continual decrease in size of fruits to the end of the season. A direct relationship was found between rainfall and both size and yields of fruits for the season. Little relationship was found between the number of canes left per plant and plant yields. (31 pages, 15 figures, 11 tables.)

JOURNAL ARTICLE ABSTRACTS

NATURAL GEOGRAPHIC DIVISIONS OF LAND.—Veatch, J. O.—Mich. Acad. of Sci., Arts and Letters. 14:417-432. 1930. (Journal Article No. 36 (n. s.) from the Mich. Agr. Exp. Sta.)—Natural divisions of land are distinguished on the basis of homogeneity in soil, topography, and vegetation. Land thus considered has a different significance from classes determined on the basis of agricultural or other use, in that the divisions are more scientific and have greater permanence. The State of Michigan is subdivided into 67 natural land

divisions, and a generalized description of the soil, topography, and original forest in each is presented. The natural divisions exhibit a range in soil from sands to heavy clays, from droughty to excessively wet, from infertile and non-arable to highly productive; and in topography from flat to hilly and mountainous; and in vegetation from a great variety of mixtures of hardwood trees and of mixed conifer and hardwoods to prairie. The classification and value of agricultural land in Michigan is frequently determined by lack of uniformity or the association of various kinds of soils in small bodies.

AGRICULTURAL REGIONS IN MICHIGAN.—Hill, E. B.—Papers Mich. Acad. Sci., Arts and Letters. 14:367-376. 1930. (Journal Article No. 37 (n. s.) from the Mich. Agr. Exp. Sta.)—The main purpose of this paper is to present information relating to the different agricultural regions in Michigan, which would be of value in the study of the geography of the agriculture of this state. An agricultural region is designated as one in which the majority of farms have similar crop and livestock organizations and are operated under similar physical and economic conditions. It is especially necessary that we consider the variations in the agriculture of Michigan in the application of certain economic findings to the agriculture of the state. On the basis of the type of farming followed, the state has been divided into 14 different regions. The delineation of the different regions was based upon the kinds, as well as the amounts, of the different crop and livestock enterprises. The major factors determining the crop and livestock combinations in Michigan are climate, soil, kind and distance of markets and topography.

THE CHERRY CASE-BEARER, COLEOPHORA PRUNIELLA CLEMENS IN MICHIGAN.—Hutson, R.—Jour. Econ. Entom. 24 (1):54. 1931. (Journal Article No. 55 (n. s.) from the Mich. Agr. Exp. Sta.)—Cherry case-bearer infestation in Michigan is general over the Old Mission peninsula, where it caused a defoliation of from six to fifteen per cent in 1930.

A DEVICE FOR ASEPTIC DISTRIBUTION OF CULTURE MEDIA.—Mallmann, W. L.—Am. Jour. Public Health. 21:288. 1931. (Journal Article No. 57 (n. s.) from the Mich. Agr. Exp. Sta.)—The glass cone used for shielding the filling tip of the apparatus used for distributing culture media aseptically into test tubes has never been fully satisfactory due to breakage. A copper unit plated with nickel or chromium is described.

The Bulletins of this Station are sent free to such individuals as may request them. Address all applications to the Director, Agricultural Experiment Station, East Lansing, Michigan.

LIST OF AVAILABLE BULLETINS

Regular Bulletins—

262 Suggestions on Planting Orchards.

264 Second Report of Grade Dairy Herd.

267 Michigan Weeds (only to Michigan libraries and teachers. Others 25c).

277 Studies in the Cost of Market Milk Production.

281 Beautifying Farm Home Grounds.

284 Some Information and Suggestions Concerning the Use of Phosphorus.

286 Studies and Cost of Milk Production—No. 2

Special Bulletins—

71 Studies in the Range and Variation of the Per Cent of Butter Fat in the Milk of Individual Cows.

83 Key to Orthoptera of Michigan.

90 Special Report of the Upper Peninsula Experiment Station.

91 Lime for Michigan Soils.

94 The Financial History of a Twelve-Year-Old Peach Orchard.

98 Vinegar.

100 Soy Beans.

101 Oats in Michigan.

106 Sugar Beet Growing in Michigan.

107 Diseases of Bees in Michigan.

110 Special Report of the Upper Peninsula Experiment Station.

111 Studies in City Milk Distribution.

120 The Microscopic Identification and Determination of the Specific Ingredients in Stock Feeds.

123 Second Growth Hardwood Forests.

124 The Colorimetric Hydrogen-ion Determination as a Means of Locating Faulty Methods at City Milk Plants.

126 An Analysis of the Peach Variety Question in Michigan.

127 Nitrogen-Carrying Fertilizer and the Bearing Habits of Mature Apple Trees.
128 Sandy Soils of Southern Peninsula of Michigan.
130 The Clovers and Clover Seed Production in Michigan.
135 Seasonal Management for Commercial Apiaries.
138 Rural Highways.
139 Tourist Camps.
141 Profitable Pruning of the Concord Grape.
142 Grafting in the Apple Orchard.
143 Winter Pruning the Black Raspberry.
144 Spraying Dewberries for Anthracnose.
147 Cherry Leaf Spot.
149 Eighty Winters in Michigan Orchards.
*150 **Emergency Hay and Pasture Crops.**
151 Buckwheat in Michigan.
152 Sweet Clover.
153 Peppermint Growing in Michigan.
154 Hardy Shrubs.
155 The Mint Flea Beetle.
156 Investigation With Strains of Beans.
157 Celery Culture in Michigan.
158 A Suggested Bacteriological Standard for Ice Cream.
159 Production of Ice Cream With a Low Bacterial Count.
160 Why a Cull Apple Is a Cull.
161 Varieties and Locations as Factors in Apple Production.
162 Pruning the Red Raspberry.
163 Forest Planting in Michigan.
†164 Diagnosing Orchard Ills.
165 Management Methods in the Raspberry Plantation.
166 Studies in Orchard Management with Special Reference to Cherry Production.
167 Chicory Growing in Michigan.
169 Profit and Loss in Pruning Mature Apple Trees.
170 The Detroit Milk Market.

*Bulletins listed in bold faced type are recent publications of this Station.

†This is a popular bulletin on the identification of the more common disorders of tree fruits in Michigan. It should be found generally useful as a work of reference for practically everyone interested in the raising of fruit.

Because of the unusual expense of the color plates it will not be distributed to the entire mailing list but will be sent to those who specifically request it, upon the receipt of ten cents (coin or stamps).

171 Farmers' Co-operative Buying and Selling Organizations in Michigan.
172 Farm Real Estate Assessment Practices in Michigan.
173 The Principal Bulb Pests in Michigan.
174 Spraying Calendar.
175 The Rural Cemetery.
176 The Uses of Cut Flowers.
177 The Significance of Soil Variations in Raspberry Culture.
179 Forest Insurance and Its Application in Michigan.
180 The Soils of Michigan, Grayling Sand.
181 A Study of Town-Country Relationships.
182 Strawberry Growing in Michigan.
183 Common Pests of Field and Garden.
184 Size of Peaches and Size of Crop.
185 Roadside Marketing in Michigan.
186 Chrysanthemum Breeding.
187 What Makes Some Farms Pay.
188 Pollination of Orchard Fruits in Michigan.
189 The Marketing of Michigan Milk.
190 Oak Forests of Northern Michigan.
191 Barley for Michigan Farms.
192 Causes and Effects of Soil Heaving.
193 Cantaloupe Production in Michigan.
194 The Use of Peat in the Greenhouse.
195 Maintaining the Productivity of Cherry Trees.
196 The Farm Woodlot in Michigan.
197 Oat Tests at the Michigan Experiment Station.
198 Combine Harvester Threshers in Michigan.
199 Studies in Swine Feeding, Parts I, II, III.
200 Hogging Off Corn.
201 The Influence of Sugar and Butterfat on the Quality of Ice Cream.
202 The Propagation of the Highbush Blueberry.
203 Spraying Materials and the Control of Apple Scab.
204 Investigations of Corn Borer Control at Monroe, Mich.
205 Soil Fertilization for Sugar Beets.
206 Types of Farming in Michigan.
208 Service Institutions and Organizations in Town-Country Communities.

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Kellogg Demonstration Farm and Wild Life Sanctuary, Kalamazoo County, 900 acres donated by W. K. Kellogg; C. M. McCrary, Superintendent.
Monroe, Monroe County, Corn Borer Station, 7½ acres rented.

MICHIGAN AGRICULTURAL EXPERIMENT STATION QUARTERLY BULLETIN
Vol. XIV, No. 1, August, 1931

FERTILIZING HEAVY SOILS INCREASES ALFALFA YIELDS

Continuous Production of This Legume Reduces Available Supply of Phosphorous and Potassium

R. L. COOK, SECTION OF SOILS

The value of alfalfa as a soil builder is well recognized and this reputation has led many to believe that maximum yields may be obtained without the use of commercial fertilizer. Alfalfa is a heavy feeder on phosphorus and potassium and after it has been grown continuously on the same soil for many years, a depletion of these elements is inevitable.

In view of the high percentage of phosphorous and potassium in the alfalfa plant, one is led to believe that the addition of these two forms of plant food as a fertilizer would be beneficial to the crop. Experimental results on several of the heavy types of soil in eastern Michigan show this is true.

Wheat Fields Should Be Well Fertilized If They Are To Be Seeded To Alfalfa

On most of the heavy soils, it is customary to seed alfalfa with a nurse crop. Wheat and barley are most often used, although good results are sometimes obtained with oats as a nurse crop. Where alfalfa is seeded with a small grain, it is essential to bear in mind that plant food is being applied for both crops when the small grain is fertilized.

Experiments have been conducted in a number of places in an endeavor to obtain fertilizer results over one or more complete rotations. In cases of this kind, fertilizers applied for the grain crop have caused large increases in the yields of alfalfa the following year.

The results presented in Table 1 were obtained on a Brookston clay loam soil. This soil has a very dark gray, friable, silty clay loam surface soil extending to a depth of about seven inches. It is well drained and not in need of lime. The fertilizer was broadcast before the seeding of wheat in the fall of 1927. Disregarding the beneficial effect on the wheat, which was considerable, it is apparent that phosphoric acid caused a large increase in the growth of hay. When the amount of phosphoric acid was doubled, the profit was increased from $7.75 to $13.95 per acre.

The addition of potash to the fertilizer, making an 0-16-10, increased the yields sufficiently to return more profit than did the 0-16-0. A larger quantity of potash increased the yield of hay still more, but the cost of the fertilizer was so great that less profit was obtained.

These results indicate that on this type of soil, on fields where manure has not been applied recently, 500 pounds of a fertilizer high in phosphoric acid and containing considerable potash, such as 0-16-8 applied with the wheat crop, may be depended on to materially increase the alfalfa crop the following year.

On another farm of the same soil type, plats receiving manure and superphosphate produced just as much hay as adjoining plats receiving a complete fertilizer. This leads to the conclusion that on farms where large quantities of manure are applied each year superphosphate may be sufficient for the alfalfa crop. It must be remembered, however, that when the fertilizer is purchased the needs of the wheat should also be considered.

Table 1.—The effect of fertilizers on the yield of alfalfa on Brookston loam.

Treatment*	Dry hay per acre 2 cuttings, 1929	Increase due to fertilizer	Value of increase	Cost of fertilizer	Profit
0-16-0 250 lbs	4,380 lbs.	1,320 lbs	$10 05	$3 30	$7 75
0-16-0 250 lbs	5,040 lbs.	1,980 lbs.	14 85	4 74	10.11
Check	3,360 lbs.				
0-16-0 500 lbs.	5,800 lbs.	2,740 lbs.	20 55	6 60	13 95
0-16-10 500 lbs	6,360 lbs.	3,300 lbs.	24 75	9 48	15 27
Check	2,760 lbs.				
0-16-20 500 lbs.	6,560 lbs.	3,500 lbs.	26 25	12 35	13 90

*The fertilizer was applied broadcast before the seeding of wheat in the fall of 1927. Increase due to fertilizer is the plat yield minus the average yield of the two checks.

In all the calculations alfalfa hay is considered to be worth $15.00 per ton. The cost of the fertilizers is calculated on the basis of $3.75 per unit for nitrogen, $0.90 per unit for phosphoric acid, $1.15 per unit for potash, and $12.00 per ton overhead cost. Profit is taken as being the value of the increase in yield minus the cost of the fertilizer. Loss is the cost of the fertilizer minus the value of the increase in yield.

Table 2.—The effect of fertilizers on the yield of alfalfa on Wisner silt loam.

Plot	Treatment*	Yield dry hay per acre 1930	Increase due to fertilizer lbs.	Value of increase		Cost of fertilizer	Profit	Loss
				Wheat 1929	Alfalfa 1930			
103	4-0-8 250 lbs	762 lbs.	120	$0.19	$0 90	$4 52		$3.62
104	4-8-8 250 lbs	1,212 lbs.	568	21 01	4 26	5 42		1 16
106	4-16-8 250 lbs	2,391 lbs.	1,744	18 26	13.08	6.32	$6.76	
201	0-16-0 250 lbs	2,989 lbs.	1,949	18 34	14.62	3.30	11.32	
203	0-16-8 250 lbs.	3,734 lbs.	2,708	16.14	20 31	4.45	15.86	
204	2-16-8 250 lbs.	3,366 lbs.	2,353	23 30	17.65	5.39	12.26	
206	4-16-8 250 lbs.	3,398 lbs.	2,306	17 03	17.30	6.32	10 98	
207	8-16-8 250 lbs.	2,776 lbs.	1,591	26.28	11.93	8.20	3.73	
209	4-16-8 500 lbs.	4,668 lbs.	3,390	19.10	25.43	12.64	12 79	

*The fertilizer was applied broadcast before the seeding of wheat in the fall of 1928.

A similar experiment was conducted on Wisner silt loam. This soil is much like the Brookston although it usually contains more organic matter and is strongly alkaline. The results presented in Table 2 show that phosphoric acid has a strong tendency to increase the yield of alfalfa while nitrogen has very little effect. As it had been nearly two years since the fertilizer was applied, the nitrogen was probably all leached away or had been used up in the wheat crop. Nitrogen and potash without phosphoric acid caused an increase of only 120 pounds of hay. When the entire cost of the fertilizer was considered, there was a loss of $3.62 per acre. When 8 per cent of phosphoric acid was added, the loss was cut down to $1.16 per acre. On the plat receiving 4-16-8, there was a net gain of $6.76 over the fertilizer cost. The plats which received no nitrogen produced just as much hay as those which did get nitrogen and as a result the lower cost of the fertilizer caused a much higher profit. In the case of the 0-16-8, the profit was $15.86 per acre. Plat 209, receiving 500 pounds of 4-16-8, produced the highest yield of any of the plats but the high cost of the fertilizer cut down the net gain until it was less than on the plat treated with 250 pounds of 0-16-8.

The results from this field show that on every plat treated with phosphoric acid the increase in the wheat crop alone more than paid for the fertilizer. This being the case the increase in the alfalfa crop was all clear profit. There should be no hesitation then in recommending that at least 250 pounds of 0-16-8 should be applied for best results with the alfalfa crop.

Wheat is a crop that requires considerable available nitrogen so, to do justice to both the wheat and alfalfa crop, a complete fertilizer should be used on both of the soil types discussed. If considerable barnyard manure or green manure is used in the rotation, a 2-16-8 or 2-12-6 may suffice, otherwise a 4-16-8 should be used.

Experiments on other types of heavy soils such as Miami loam and Miami silt loam have produced results similar to those obtained on the Brookston and Wisner soils. As these soils make up the bulk of the heavy soil areas in eastern Michigan, a rather general statement can be made to the effect that wheat which is to serve as a nurse crop for alfalfa on these soils should be treated with a liberal quantity of fertilizer containing a high percentage of phosphoric acid with moderate quantities of potash and nitrogen.

EFFICIENCY OF SURFACE MILK COOLERS TESTED

Comparison of Different Types of Equipment Shows Variations in Temperature Reductions

G. MALCOLM TROUT, SECTION OF DAIRY HUSBANDRY

Several methods of cooling milk are used, but the placing of cans of milk in a tank of cold water is a general practice in the milk producing areas. For efficient milk cooling by this method, at least six or seven gallons of water at the temperature of Michigan well water, 48°-50° F., are required for each gallon of milk cooled. A certain amount of time is required as well. As a general rule, from 30 to 60 minutes, depending upon the amount of stirring, are required with this method to reduce the temperature of the milk to a safe temperature for storage and subsequent transportation to market.

The time element in the tank method of cooling is a problem on some farms located at the beginning of the hauling route where the milk hauler begins early in the morning to gather his load. Frequently, in such locations, the morning's milk is either uncooled, or insufficiently cooled; and it often arrives at the receiving station at a high temperature or in an off-flavored condition, and is, therefore, rejected.

The surface cooler is a quick method of reducing the milk's temperature. Where the milk house and cooler are located near the stable and each cow's milk is immediately placed in the cooler, practically all the milk is cooled when the milking is completed. The time element is, thereby, reduced to a minimum.

The question has been raised repeatedly as to the water requirements of surface type milk coolers. Water under pressure must be used in this method of cooling. To determine the water requirements of the surface type cooler, tests were made on five different coolers.

Cooler number one was of the conical, smooth surface, steep-sided type. It is constructed to use running water, but since the water reservoir holds approximately 25 gallons, the cooling is often done by the water contained in this reservoir only. When running water is used, the water enters from the side at the bottom from where it rises to an overflow pipe at the top.

Cooler number two was a cone shaped, spiral tubular cooler in which the milk is cooled as it flows down over the outer side of the corrugated cone. The slant of the tubes seems to carry the milk along the tubes before it flows down to the next tube below. Cooler number three consisted of a hollow, two-walled cylinder about as long as the

height of a ten gallon can. This type of cooler is designed to be placed in the can of milk. Its thin walls and open center permits it to be placed in the can without displacing much milk. The water enters at the top on one side, passes between the two walls and flows out at the top on the opposite side.

Coolers number four and five resembled each other in construction, each being of the horizontal tube type. Cooler number four consisted of a fewer number of larger tubes with a flange and an air space between the tubes. Cooler number five consisted of many similar tubes fitted closely together. In both of these coolers as well as in cooler number two, the counterflow system of water cooling was used.

Ten gallons of milk were cooled in each test over each cooler. A water meter was attached so that the amount of water used by each cooler could be determined accurately. The initial and final temperature of each lot of milk were also recorded. The results of the water requirements of the different coolers are presented in Table 1.

Table 1.—Amount of water required by various surface type milk coolers to bring about definite cooling.

Number	Distinguishing characteristics	Initial temperature of water °F.	Initial temperature of milk °F	Gallons of milk cooled	Gallons of water used	Final temperature of milk °F.	Gallons of water per gallon of milk
1	Conical straight sided	58	93	10	50 0	65	5 00
		58	93	10	15 0	64	1 50
		52	93	10	37 9	76	3 79
2 ..	Spiral tubular	52	93	10	85 0	58*	8 50
		52	93	10	50 0	59*	5 00
		52	93	10	23 0	62	2 30
3	Submerged hollow cylinder	52	93	10	200 0	68	20 00
		52	93	10	100 0	75	10 00
		52	93	10	50 0	78	5 00
		52	93	10	25 0	86	2 50
4...	Large horizontal tubes open	52	93	10	102 0	57*	10 20
		52	93	10	50 8	59*	5 08
		52	93	10	30 0	62	3 00
5... ..	Small horizontal tubes closed.	52	93	10	97 0	56*	9.70
		52	93	10	44 0	58*	4 40
		52	93	10	27 9	60	2 79

The utilization of the refrigeration contained in the cooling medium under average rate of flow is of importance since it denotes in general the efficiency of the cooler. Likewise, the time required for the milk to flow over the cooler and the final temperatures of cooling under normal working conditions are of especial value to the milk producer. Tests were made with each cooler to compare those qualities. The results secured are tabulated in Table 2.

Since all the coolers did not have equal cooling surface areas, or

equal faucet openings, tests were made to determine the comparative number of heat units extracted from the milk per unit of time per square inch of surface. The results are given in Table 3.

An examination of Table 1 shows that, of the five coolers used, three yielded a milk with a final temperature below 60° F. These three coolers were number 2, 4 and 5, the spiral tubular, the large horizontal tube open, and the small horizontal tube closed. The average of the temperatures below 60° F. was 58° F. The average water requirement per gallon of milk necessary to secure this temperature was 7.1 gallons. In these three coolers, the counter flow water system is used, the water entering under pressure at the bottom and passing out at the top of the cooler, while the milk flows by gravity down over the surface. The milk on leaving the cooler comes in contact with the coldest water. In the other two coolers, the counterflow system is not in use, and, consequently, a low temperature of cooling could not be obtained.

The range in time of cooling with the surface coolers studied, as shown in Table 2, is from six to twelve minutes. The upper limit in

Table 2.—Comparison of the various surface coolers in respect to the utilization of the refrigeration of water under normal flow, the time required for cooling a definite volume of milk, and the final temperature of the milk.

Cooler number	Condition of operation	Gallons of milk cooled	Initial water temperature (°F.)	Final water temperatur (°F.)	Initial milk temperature (°F)	Final milk temperature (°F.)	Time of cooling (minutes)
1........	Water unstirred	10	52	62	93	76	10½
1.........	Water stirred.	10	52	67	93	70	11
2........	Faucet full open	10	52	58	93	61	7½
2....... . .	Faucet one-half open... ...	10	52	56	93	57	12
3.........	Cooler in milk 7 minutes..	10	52	58	93	82	7
3.........	Cooler in milk 12 minutes..	10	52	58	93	75	12
4.........	Faucet full open...	10	52	55	93	56	6
5.........	Faucet full open..........	10	52	56	93	54	6

time is dependent largely upon the degree of opening of the milk faucet, while the lower limit is determined by the size of the faucet. Coolers numbers 4 and 5 yielded 10 gallons of milk at 56 and 54 degrees F., respectively, within six minutes. At this rate of cooling, these

coolers had a cooling capacity of 1.66 gallons of milk per minute when a normal flow of water was used.

The ability of the cooler to utilize the refrigeration of the cooling medium will determine largely its efficiency as a cooler. Coolers one and three were very poor in this respect. The tubular coolers numbers 3, 4, and 5, making use of the counterflow of the cooling medium were far superior to the others in the utilization of the refrigeration contained in the water.

The surface coolers shorten the time required to cool the milk very materially. The efficiency of the surface milk cooler is dependent upon the course of the cooling medium flowing through it, upon the rate of milk flow, and upon the rapidity of the milk itself in passing over the cooling area. It is obvious that at least as much water is required in cooling milk by the surface cooler method as by the tank method.

Table 3.—Comparison of the various surface coolers in respect to their ability to extract heat from milk per minute per square inch of cooling surface.

Cooler number	Gallons of milk cooled	Gallons of water used	Time of cooling (minutes)	Approximate total cooling surface (sq in)	Approximate total heat units extracted	Heat units extracted per sq in. cooling surface	Heat units extracted per sq. in. per minute
1	10	15 0	11	877	1645	1 97	.18
	10	37 9	11	877	2226	2 54	24
	10	50 0	11	877	2710	3 09	28
2	10	23 0	7	880	3002	3 41	.49
	10	50 0	7	880	3291	3 74	.53
	10	85 0	7	880	3388	3 84	.57
3	10	25 0	4	767	677	88	.22
	10	50 0	7	767	1452	1 89	27
	10	100 0	9	767	1742	2 27	25
	10	200 0	12	767	2420	3 15	.26
4	10	30 0	6	1297	3002	2 39	40
	10	50 8	6	1297	3291	2 53	42
	10	102 0	6	1297	3484	2 69	45
5	10	27 9	6	1297	3194	2 46	41
	10	44 0	6	1297	3388	2 61	44
	10	97 0	6	1297	3581	2 76	46

FIND METHOD TO CONTROL ROOT-KNOT OF PEONY

Hot Water Treatment Kills Eelworm in Galls on Plant Roots

RAY NELSON, SECTION OF BOTANY

The herbaceous Chinese peony, *Paeonia albiflora,* is one of the most popular and widely grown of all the hardy perennial flowering plants. Always a favorite in the old fashioned garden and border, the peony has won thousands of new enthusiasts through the introduction of greatly improved varieties. This plant possesses a combination of desirable features surpassed by few, if any of the other flowering perennials. The appeal of the peony is based upon the ease with which it may be grown, perfect hardiness, regularity of blooming, and the form, color, variety, and fragrance of the flower.

The most nearly ideal conditions for the culture of the peony are found in the northern states and it is within this area that the plant is most widely grown and admired. In general, the plant does not thrive in the warmer, southern latitudes. The commercial production of peonies is practically limited to the northern states, and, within a relatively few states, millions of plants consisting of several hundred varieties are produced. The peony is very extensively cultivated in a commercial way in Michigan. Several hundred acres of plants are grown in the various nurseries of the state and the plantings appear to be increasing yearly.

The statement has frequently been made that the peony is not attacked by any serious plant disease and that this accounts for the relative ease with which it may be grown. Though it is true that many other ornamental plants are more seriously affected by disease than the peony, there are several diseases which are very troublesome and frequently cause great losses to the growers of this plant. Within recent years, the root-knot disease caused by the parasitic eelworm *Caconema radicicola* has become increasingly important and is responsible for many of the complaints of plants failing to produce flowers.

The root-knot disease is not limited to the peony but is widespread as a pest of more than 600 different kinds of plants. It has long been a serious disease in Michigan greenhouses but it has been observed only within a comparatively recent time as the cause of losses on crops grown out of doors. Nursery stocks in the warmer sections of the State have, in some cases, become seriously infested with this parasite,

very likely due to the importation of plants from sections where root-knot is a common disease. At the present time, peonies in the southern and southwestern sections of Michigan are more or less infested with the root-knot nema, and there is no doubt whatever that the disease is on the increase and that attention must be given to the control and eradication of this threatening disease in the nursery plantings of peonies. In southwestern Michigan, the prevailing sandy types of soils are, of necessity, utilized for the production of nursery stocks. Some advantages accrue from the production of plants on the lighter soils but the peony does not grow best on sandy soils and root-knot is decidedly more serious on light, porous soils.

Peony plants which are stunted in appearance and which produce many slender or wiry shoots that are much shortened and barren of flowers should be suspected of infestation with the root-knot nema, Fig. 1. Too deep planting of the roots and Lemoine's disease, another

Fig. 1.—A peony plant affected by the root-knot disease. The dwarfed growth and "wiry" shoots are characteristic. Healthy plants on either side.

very serious disease of the peony, will also cause the plants to react in this way, but the most common cause of this type of growth is root-knot. A young peony plant in good health should produce relatively few shoots. These should be strong and vigorous and practically every one should bear flowers. The shoots of root-knot plants are produced in much greater numbers and are shorter than those from normal plants. They are much smaller in diameter, being commonly designated as "wiry" and seldom, if ever, produce flowers. These stunted, proliferous and sterile shoots afford a ready means of identifying plants affected with the root-knot disease.

At digging time, roots infested with the nemas are easily identified by the galls or knots that are borne on the fibrous and fleshy roots, Fig. 2. These galls vary greatly in size; on the fibrous roots, they may not be larger than a small pea but they may attain the size of marbles

on the fleshy roots. The galls may be few in number or badly infested plants may have hundreds of galls distributed irregularly over the fibrous and fleshy roots. In Lemoine's disease, the galls that are formed on the roots have a more or less geometrical arrangement,

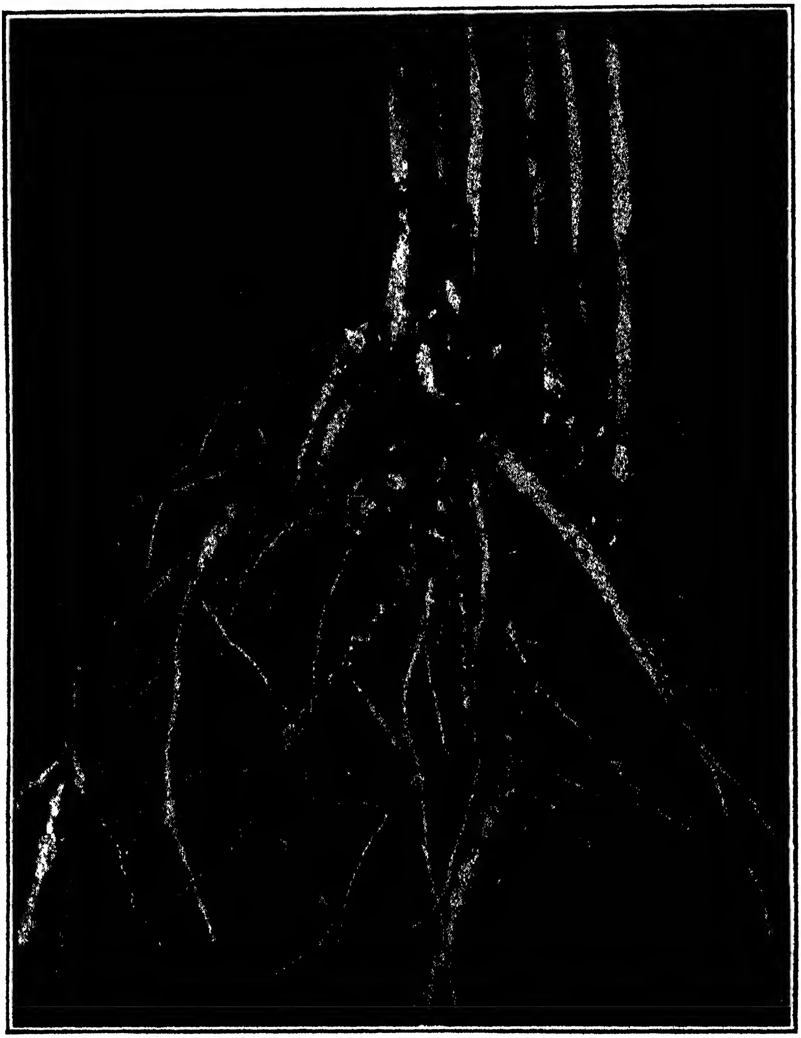


Fig. 2.—A peony root showing the galls or knots on the roots due to infestation with the root-knot nematode, *Caconema radicicola.*

being spaced at rather definite intervals and formed more abundantly on the larger roots. They also involve the entire diameter of the root while the galls caused by the nemas frequently affect only one side, Fig. 2.

The root-knot disease is caused by a microscopic, parasitic eelworm, *Caconema radicicola.* The pear-shaped female may sometimes be dis-

tinguished in an opened gall by the unaided eye but usually a microscopic examination is necessary to disclose their presence. The worms penetrate the peony roots from infested soil by means of a small spear with which they pierce the tissues of the root. Once inside, their presence causes the cells of the root to enlarge enormously in size to form the galls which typify the root-knot disease. In warm, moist, sandy soils the eelworms increase rapidly, and spread through the soil by their own efforts or are transported on tools, shoes, or by running water. Once the parasite is introduced in the soil, its spread is usually gradual and a long time may be required for it completely to infest a field but it may be very quickly disseminated by cultivation or by rain washing infested soil to non-infested locations. The original introduction of the parasite may result from the planting of a diseased peony root or any nursery stock infested with the parasite.

The general occurrence of root-knot on peonies in Southern Michigan and an increasing demand for information has led to some investigations toward controlling this disease in nursery stocks. Since there appears to be little if any varietal resistance to root-knot, very valuable varieties of peonies are frequently affected with the disease. The destruction of these roots would entail serious losses to the grower and in some cases might result in the extermination of valuable varieties. Accordingly, some method of freeing infested roots of the eelworms would be a decided advantage in combating this disease in infested stock. Successful methods of eradication of parasitic eelworms of other species have been devised and consist of treating infested stock with hot water. Thus, the stem nematode which attacks narcissus can be eliminated by treating infested bulbs for a definite length of time in hot water. Experiments with hot water treatments of diseased roots were begun in the autumn of 1928 and these preliminary tests provided information for a more extensive experiment in 1929.

A number of roots of several varieties of peonies infested with root-knot were obtained in September 1928. These were divided into standards 3-5 eye divisions and treated immediately. All of the roots were first given a pre-soak for 10 minutes at a temperature of 100° F. Divisions of four varieties were then given a treatment in hot water at a temperature of 120° F. for 20 minutes. Divisions of five varieties were treated at the same temperature for 30 minutes. Untreated divisions of four varieties were kept for checks. The roots were taken directly from the hot water, washed in cold running water for several minutes and planted immediately in fertile, sandy loam soil. The treatments were given and the roots planted in the field on September 12, 1928.

The roots were dug and examined in September 1929. The growth of the treated plants during the growing season and the condition of the roots at digging time was so satisfactory that further tests were conducted. All of the untreated roots were severely infested with nematodes while the treated ones, especially those treated for 30 minutes, were practically free of the disease. Nematode-infested roots of Mons. Jules Elie, Avalanche, and Therese were obtained in October and given the hot water treatment at three different temperatures.

The standard 3-5 eye divisions were used throughout. All of the roots were first pre-soaked for 20 minutes in warm water at a temper-

ature of 100° F. They were transferred directly from the warm water to the treatment tank in which the water was held at the desired temperature by live steam led into the bottom. The temperature of the water was checked by a thermometer standardized by the U. S. Bureau of Standards. In none of the treatments did it vary by more than 1° F. The roots were treated as follows:

Hot Water Treatments for Root-knot

25 roots, temperature 115° F. 1 hour
25 roots, temperature 120° F. 30 minutes
20 roots, temperature 125° F. 10 minutes
15 roots, untreated.

The roots were removed from the tank of hot water and immediately cooled in running cold water. They were treated on October 28 and planted the same day in a sandy loam soil. Because of the late date of planting, a mulch consisting of several inches of straw was placed over the roots. This was removed before the shoots appeared in the spring.

Notes were taken in the spring to record the effect of the treatments upon the time of the emergence of the shoots and the injurious effects, if any, upon the growth of the plants. The roots were not killed by any of the treatments but considerable difference was noted in the time of the appearance of the shoots. In general, the roots treated for 30 minutes at a temperature of 120° F. produced the most satisfactory growth. The shoots were much delayed from the roots treated at 125° F. for 10 minutes. Eventually the shoots appeared from all of the roots and by midseason the growth was apparently normal in the plants from the treated roots.

In September, 1930, the roots were dug and examined for evidence of root-knot. The results of the treatments are given in the table.

Effect of Hot Water Treatments Upon the Control of Root-knot

No. plants	Temperature	Duration of treatment	Results
25	115° F.	1 hour	4 healthy, 7 slightly infested, 13 badly infested, 1 dead.
25	120° F.	30 minutes	17 healthy, 4 plants with few galls, 4 severely infested.
20	125° F.	10 minutes	8 healthy, 10 lightly infested, 1 heavily infested, 1 dead.
20	Untreated		4 healthy, 3 lightly infested, 13 badly infested.

The success of the treatment was gauged by the freedom from galls of the new roots. The treatment does not eliminate the old galls but if the nematodes have been killed no new knots will appear on the roots that are formed the following year. None of the treatments were 100 per cent successful in killing the nematodes but the roots treated for 30 minutes at a temperature of 120° F. were comparatively

freed of the parasite. This treatment gave practically 70 per cent clean plants from the treated roots as compared with 40 per cent in the next best treatment and only 20 per cent in the untreated ones. The treated plants produced excellent flowers in 1931 and their growth is satisfactory in every way.

From the result of this experiment, it seems very probable that peony roots infested with the root-knot nema can be comparatively freed of this parasite by the hot water treatment. The treatment will not be completely successful, especially if the roots are replanted on sandy soils. The hot water treatment combined with planting on a fairly heavy clay loam soil would undoubtedly give better results. Since the peony seems to thrive best on the heavier soils, they should not be grown in sandy soils where clay is available. The hot water treatment will, however, clean up infested roots that are grown in the lighter soils and should be useful in the saving of valuable varieties. With the cheaper varieties, the discarding of roots showing the result of nematode infestation would probably solve the problem most satisfactorily. For the grower of a few peonies in the border or home perennial garden, the discarding of infested roots and the obtaining of clean ones is to be preferred because of the difficulties involved in applying the hot water treatment. For the nurseryman who grows large numbers of roots, in many cases including infested roots of very valuable varieties, the hot water treatment provides a method of saving this stock.

Precautions are necessary in applying the treatment if satisfactory results are to be obtained. An accurate thermometer is essential and one is to be preferred that has been checked by the Bureau of Standards or that has been compared with one of these instruments and any corrections allowed for. If the temperature goes too high, the roots will be injured; if it falls below the maximum, the parasite will not be killed. The following recommendations should be adhered to in giving the treatment:

(1) Dig the roots and allow them to dry for two or three hours until they are no longer brittle. Divide them into standard 3-5 eye or smaller divisions.

(2) Pre-soak the divisions in warm water at a temperature of 100° F. 15 to 20 minutes.

(3) Have the water in the treatment tank at a temperature of 121° F. when the roots are ready for immersion. Transfer the divisions to this tank and see that all of the roots are submerged at all times.

(4) Keep close check on the temperature and do not allow it to fall below 119° F. nor to rise above 121° F. Use live steam if available to keep the water at 120° F. or have a constant supply of boiling water close at hand to add to the water in the tank.

(5) Remove the roots after 30 minutes immersion at 120° F. and cool them immediately in running cold water.

(6) **Do not replant the roots in infested soils.** The value of the treatment will be lost unless the treated roots are planted in soils that are free from the nemas. Plant in fertile clay soil if possible. The peony prefers a fairly heavy clay soil containing adequate supplies of organic material.

(7) Do not plant too deeply, cover the eyes or buds with about two inches of soil. Deep planting is one of the chief causes for the production of poor roots and no flowers.

(8) After the ground is frozen, apply a mulch of straw or other material. This will not be needed the second season.

METHOD TO TELL POWER STREAM WILL FURNISH

Temporary Weir Dam Permits Measurement of Water and Gives Data to Compute Horsepower

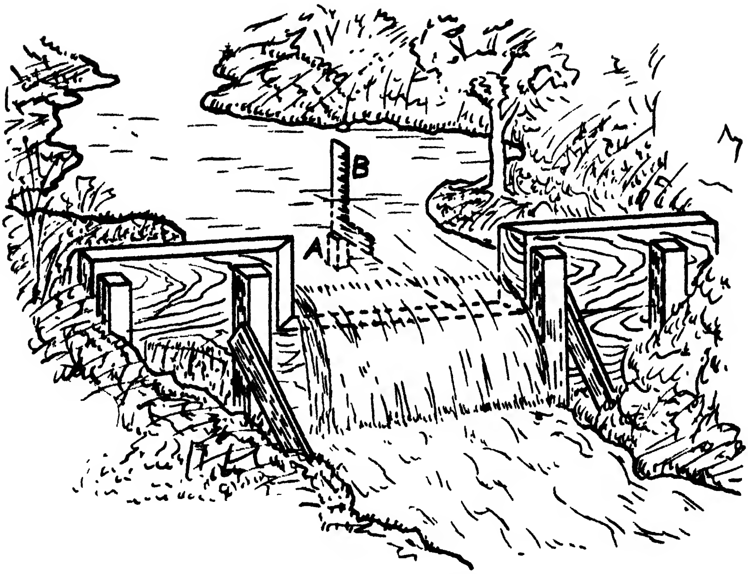
W. H. SHELDON, SECTION OF AGRICULTURAL ENGINEERING

There are in Michigan a number of small streams which if harnessed would furnish power enough to generate electricity for lights and small household appliances.

The factors which determine the power which a stream is capable of developing are the height of the dam which may be used and the quantity of water flowing in the stream. The height of the dam is limited by the height of the banks and may be measured by using a carpenter's level and a rule. The quantity of water flowing may be determined by means of a weir dam, Figure 1.

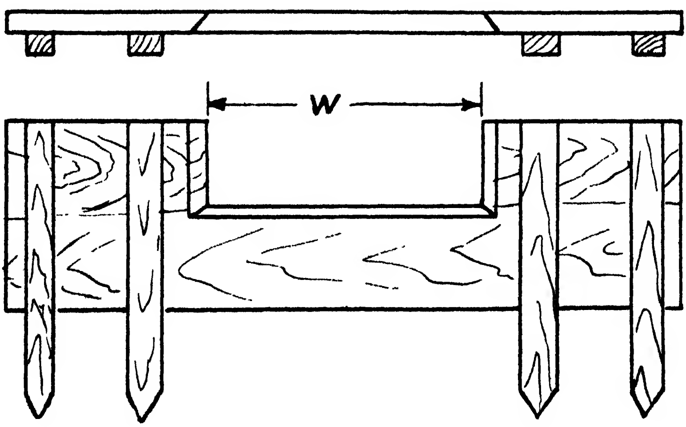
The weir consists of a rectangular notch cut in a temporary dam across a stream. The notch should be centered and its width not more than two-thirds the width of the dam. It should be sufficiently wide, however, so that the water flowing over the lip will be not more than ten inches or less than one inch deep. The depth of water flowing over the weir should not be more than one-half the drop outside. The edges of the notch should be beveled on the sides and bottom as shown in Figure No. 2 to afford as little resistance as possible to the flow of water. It is essential that the dam be made high enough so that the water will be quiet before reaching the weir and that the weir be wide enough so that the flow will not be too rapid.

Since the surface of the water above the dam slopes toward the notch the depth of the water flowing over the weir must be measured a few feet up-stream. In order to do this set a stake (A) four feet back of the weir with its top exactly level with the lip of the weir. An ordinary rule (B) set on this stake serves to measure the depth



THE WEIR DAM

of water flowing over the lip. The depth of water and the width of the weir being known the volume of flow is:



$Q = 3 \times w \times d\sqrt{d}$

Where Q = discharge in gallons per minute
w = width of notch in inches
d = depth in inches flowing over weir

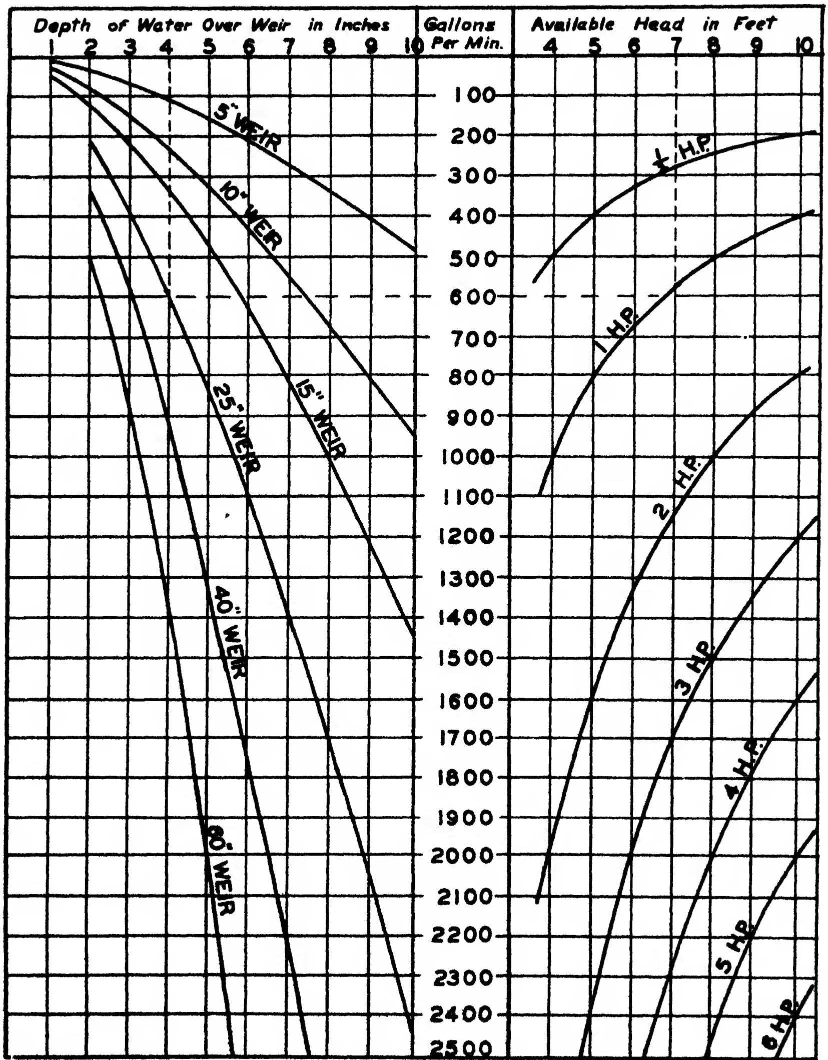
Having determined the quantity of water flowing in gallons per

minute and the available head in feet, the power that may be developed is:

$$H.P. = \frac{Q \times H}{4{,}000}$$

Where Q = gallons per minute
H = available head in feet

HORSEPOWER OF A STREAM



$Q = 3 \times W \times d\sqrt{d}$

Where Q = Discharge in Gal per Min.
W = Width of notch in inches
d = Depth in inches flowing over weir

$H.P. = \frac{Q \times H}{4000}$

H = the available Head in feet

The width of the weir, depth of water flowing over the weir and the available head being known, the horsepower may be read directly from the graph, Figure 3. Example: If a weir notch is 25 inches wide and water flows over with a depth of four inches, what power will the stream develop with a seven foot dam? By the formula

$$Q = 3 \times 25 \times 4\sqrt{4} = 600 \text{ gallon per minute}$$

$$H.P. = \frac{600 \text{ gal.} \times 7 \text{ ft.}}{4000} = 105 \text{ H.P.}$$

Turning to the graph Figure 3, following curve near left side marked 25″ Weir to intersection of vertical line under 4″ Water Depth. On a horizontal line to the right of this intersection, find the quantity 600 gallons per minute in the center column. Follow the same horizontal line to the right until it intersects the vertical line under 7 feet of head which is just to the right of the curve marked 1 H. P. which indicates that the stream will develop slightly more than 1 H. P.

General conclusions which may be drawn from the graph are:

1. With a given depth the amount of water flowing over the weir is proportional to the length of the weir.

2. With a given fall the power a stream will develop is proportional to the quantity of water available.

3. With a given quantity of water, the power a stream will develop is proportional to the fall used.

A stream developing 4 H. P. or more will operate a lighting plant without a storage battery by using a generator which will deliver a constant voltage with a turbine. The smaller streams which develop at least 1 H. P. will operate battery charging light plants satisfactorily but streams developing less than 1 H. P. are better adapted for operating hydraulic rams for pumping water. It is usually not advisable to attempt to harness a stream unless the dam can be built at least four feet high because a special large capacity turbine or under shot wheel would be required to develop even a small amount of power.

After determining that a stream will develop ample power for your needs, the expense of harnessing the stream should be carefully considered; for instance, the location of the dam site should be reasonably near the buildings where the electricity will be used in order to avoid the necessity of a long transmission line. If the banks are widely separated, a very long dam will be required and a large area will be inundated, or, if the banks are very porous there will be considerable expense in building a dam which will hold back the water.

CLASSIFICATION OF WATER SOILS IS PROPOSED

Nature of Water and Beds of Lakes, Streams, and Marshes is of Economic Importance

J. O. VEATCH, SECTION OF SOILS

The State of Michigan possesses, according to present estimates, about 1,000,000 acres[1] of water surface exclusive of the Great Lakes. Much of this land consists of lakes, a number in excess of 5,000, ranging in size from five acres, or less, to great expanses the size of Houghton lake which is 29.5 square miles in area. In addition to the lakes, there is the larger aggregate acreage occupied by the streams and by the marsh land which is permanently or periodically covered by water.

The greater part of the water covered land supports a varied vegetation which has considerable significance in relation to the propagation and maintenance of fish, wild fowl, and aquatic fur-bearing animals, while the soil is also capable of producing plants more directly useful to man. Therefore, aside from an academic or purely scientific justification, this class of land and soil is deserving of study from economic considerations. The first step in the scientific study is the construction of a scheme of classification.

Water soils occur on land which is permanently water covered, or intermittently covered for such periods that the vegetation is hydrophytic, or aquatic, in character. Soils in which water is the principal gross component can be designated as Hydrosols and such soils should have equal rank in a taxonomic scheme with the other great classes, namely; (1) common mineral soils, (2) organic soils (peat and muck), (3) rock soils. The water soils differ from the dry land mineral soils in the preponderance of water over the solid, gaseous, and organic components; while the peats and mucks differ in the preponderance of organic matter; and the rock soils in the preponderance of solid inorganic matter over the organic, liquid, and gaseous parts.

From a purely pedologic point of view the complete water soil is composed of three major horizons, or morphological parts: (1) Aqueous surface horizon; (2) the subaqueous cumulose or sedimentary horizon; (3) basal geologic substratum. The units of classification logically should be based upon the further subdivision of these parts and upon variations in their chemical and physical character. Since many plants

[1]A precise estimate of the area of water surface and number of lakes of all sizes cannot be given until detailed surveys of the whole State have been completed. The above estimate is based on examination of the present detailed soil survey maps and the U. S. Geological Survey topographic maps.

subsist almost entirely in a medium of water and since the nature of the cumulose horizon, No. 2, is also dependent to a very large extent upon the nature of the water, the chemical and physical character of No. 1 becomes of major importance in the differentiation of the soils into types. The criteria which have especial taxonomic significance are: (1) the thickness of this horizon (depth of water); (2) the chemical character according to the predominating elements or components in solution and the reaction of the water; (3) the amount and nature of the solid matter in suspension.

The second major horizon is a source of plant nutrients and a place for plant anchorage and seed storage. Its constitution, whether organic or inorganic; its thickness, texture, and consistency; and its chemical nature with particular reference to calcium, phosphorus, potassium, and nitrogen assume importance in differentiation.

The third major horizon is of less importance in classification but its chemical and physical nature may become a basis of subdivision especially where the first two horizons are of small thickness.

The following taxonomic scheme, applicable to Michigan, is presented as tentative and suggestive.

I. Lacustrine group.

  AI. Shallow aqueous horizon (tentatively restricted to less than 10 feet)

    A. Calcic water

      1. High calcic or hard water (14+ grains per gallon hardness)

        a. Sand subaqueous horizon
          Clean sand compact
          Sand-organic matter admixed
          Sand-shells or marl admixed

        b. Clay-colloid subaqueous horizon (largely inorganic)
          Dark colored muds
          Gray-green muds
          Reddish muds

        c. Slime or ooze (largely organic and gelatinous or pasty in consistency)
          Black or brown
          Grey-green

        d. Peat subaqueous horizon
          Fluid or soft
          Compact or matted

        e. Marl subaqueous horizon
          Soft or oozy
          Compact
          Nodular or pebbly

        f. Gravel—boulder bottom
        g. Hard rock bottom

2. Medium calcic water (6 to 13 grains per gallon hardness)
   (Subdivisions same as under high calcic waters)
3. Low calcic and soft or acid water (6 grains per gallon hardness)
   (Subdivisions as above except "e")

B. Saline
C. Chalybeate
D. Sulfur
} Scarcely or not at all represented in Michigan

BI. Deep aqueous horizons (10 feet or more)

II. Fluvial group (streams)

AI. Clear water

BI. Turbid or large quantity of suspended matter
Subdivisions essentially the same as under the Lacustrine group

III. Marsh and hydroperiodic group
(Subdivisions essentially the same as under shallow Lacustrine group)

The classification presented is admittedly incomplete but constitutes a beginning. A classification is essential, since geographic surveys cannot be made without one; it facilitates ecologic study and together with a survey provides the means for determining the location and geographic extent of any type favorable or unfavorable for any particular plant growth which may be determined by ecologic study and experiment.

The classification here suggested is made from the point of view of the pedologist and probably omits certain factors such as temperature, aeration, botanic composition of deposits, mineralogic and faunal composition of sediments, and physiographic and geologic origin, which might be considered important by the zoologist, the botanist, or the geologist.

In mapping, it will be found difficult in many instances to type individual lakes or to place them in a category because a number of distinct kinds of bottoms and also differences in water, with corresponding differences in vegetation, may occur within their limits. Lakes were observed where an arm or embayment contained very soft or acid water, together with a peat subaqueous horizon and such acid tolerant species as leather leaf, cottongrass (*Eriophorum*), and Sphagnum moss, while in other parts a neutral or alkaline aqueous horizon, with plants such as species of *Potamogeton* and *Ceratophyllum*, was present.

Present observations and tests in the field and laboratory indicate that the waters are predominantly calcic in character but that a wide range exists, as measured by the amount of $CaH_2(CO_3)_2$ in solution, or by hardness expressed as grains per gallon or parts per million. Expressed as hardness, tests, so far made, range from 1 to 20 grains per gallon. Three divisions are suggested as possibly having some significance in relation to plant growth. Certainly the extremely "hard" and the very "soft" waters exhibit marked difference in species of plants and character of growth. On the basis of present observations,

it does not seem possible to correlate the amount of lime in the water with that in associated surface geologic formations or soils, only in a very general way. Acid and soft waters are frequently found in association with limestone and calcareous drift, and hard waters with acid and sandy soils. The waters also exhibit a wide range in reaction, or pH, which does not correspond very closely to the hardness or amount of lime. The time, stage of water, and amount of carbon dioxide are undoubtedly factors affecting the reaction. Phosphorus is present only in extremely minute quantity, frequently so minute that delicate qualitative tests do not reveal its presence. However, analyses of the ash of plants, such as *Lemna* and *Chara,* reveal large quantities of this element.

The subaqueous horizons, or bottoms, exhibit a wide range in fertility, texture, and consistency. The fertility as expressed in volume of growth and amount of phosphorus and potash seems to be highest in the inorganic muds, although some of the marly sands and blackish peats are equally high in phosphorus. The clean wave washed sands are lowest in nitrogen, phosphorus, and potash. Marls are variable in amounts of phosphorus and potash; the high percentage of calcium carbonate and their consistency are probably the controlling factors in relation to plant growth.

The consistency of the subaqueous horizon determines the degree of permanence of anchorage of plants and root penetration and rhizome development, and therefore the abundance and persistence of certain species. Notable differences in plant growth may be correlated with clean compact sand, as contrasted with marly or peaty sand, with ooze in contrast to the compact marl and clay mud, and the soupy peat as compared with the compact matted peat.

Any particular plant may be found under a wide range of soil conditions, although it is logical to assume that some particular condition is optimum for its greatest abundance and maximum size. The determination of this optimum condition in nature will require extensive observations in conjunction with laboratory study of soils. The favorable modifications of sites for any particular species or association of plants by the addition of peat, marl, sand, stone, or by the use of commercial fertilizers can be determined only by experiment. That vegetation may be quickly changed by natural inwash of detritus or by artificial filling, as sand on peat bottoms at bathing beaches, is a matter of observation. Also experiments in the use of fertilizers in carp ponds in Germany has resulted in favorable changes in vegetation.

Statements only of broad or general correlations between plants and soils can be ventured at present, such as the more calcic water and oozy and peaty bottoms are most favorable for *Chara* and *Potamogeton;* the lake bulrush (*Scirpus*) is most abundant on the hard or compact bottoms of sand or marl; that cat-tail, *Sparganium,* and some of the species of *Pontederia* and *Sagittaria* are most prolific on the mud bottoms associated with intermediate or high calcic waters; the yellow water lily on mud and peat subaqueous horizons and the white water lily associated with the less calcic water. It may be safe to assume that most of the native aquatic and amphibious plants will grow under a great variety of lacustrine fluvial and marsh soil conditions. The extremes of turbidity, acid or alkaline water, of clean wave washed compact sand, of pure marl, of hard bed rock, and deep soupy peat seem to inhibit the growth of certain species and limit the size and abundance of others.

USING THE HARVESTER COMBINE FOR NAVY BEANS

May Be Possible To Reduce Per Acre Cost of Operating This Machine in Michigan

E. C. SAUVE, SECTION OF AGRICULTURAL ENGINEERING

When the combine harvester thresher came into Michigan in 1927, it was believed that its use would be confined largely to the harvesting and threshing of small grains. However, as the numbers increased year by year, there came a desire to extend its usefulness to the harvesting and threshing of navy beans.

As the combine was to be, in most cases, owned by individual farmers rather than a group, it was desirable to use the machine as much as possible. It was known that the acre cost of operation could be lowered only by a greater use of the machine, and in 1928, a combine manufacturer in cooperation with the Agricultural Engineering Department of the College conducted some experiments in threshing beans with the combine.

Combines had been successfully used in beans in the far west but the machines used there had two threshing cylinders such as are found on bean hullers. The combine manufacturer attempted to modify a small grain combine to incorporate some of the features of a bean huller. Consequently the first attempt in the Michigan tests was to slacken the combine cylinder speed by controlling the speed of the motor which operated it. The threshing mechanism was necessarily reduced in speed as a result of this change and the combine did not thresh satisfactorily. A speed reduction device which cut the cylinder speed about one-half was installed later and, at the same time, provision was made to maintain a normal separation speed. A special bean cylinder and concaves were installed in place of the regular small grain cylinder and concaves. This provided for wider spacing between cylinder and concave teeth. Much better results were obtained.

The total loss including the loss of beans in harvesting and placing into windrows was 6.5 per cent of the total yield. This was reasonably low but the principal difficulty arose in keeping the stones in the bean windrow from entering the machine and causing damage. During the bean harvest of 1930, additional work was carried on by two combine manufacturers. As in 1928, the fundamental idea was to make the least possible changes in the combine's construction in order to thresh beans successfully.

Two outstanding differences were the lowering of the cylinder speed to about 300 revolutions per minute and the using of the regular

cylinder and concave equipment. On the farm of Robert Stearns of Temperance, two methods of harvesting beans were used. One was to place the beans into small stacks as shown in Figure No. 1; the other

Fig. 1.—Combine is placed centrally in the field. Beans are hauled to the combine from the McNaughton stacks.

was to pull and rake several bean rows into a large windrow. The combine with a pick up attachment as shown in Figure 2 gathered these windrows and threshed at the same time.

Fig. 2.—A windrow consisting of six bean rows is picked up and carried into the combine to be threshed.

It was as late as October 13 that Mr. Stearns' beans were threshed from the windrow. A field of beans that had been put into stacks was threshed in the field by his combine which performed satisfactorily. There were no stones in his bean field to cause machinery damage and

he was fortunate that the weather permitted him to harvest these beans at such a late date.

The following table gives a brief summary of the performance of combines as compared with bean hullers and grain threshers:

Table 1.—Machinery performance for navy bean threshing.

	Threshed with combine from windrow				Threshed with beaner		
				Field stack			Special grain thresher
	Fox farm	Allen farm	Stearns farm	Stearns farm	Parker farm	Bloomquist farm	Maine farm
Date threshed	Sept. 8	Sept 23	Oct. 13	Oct. 20	Sept. 20	Sept. 22	Mar. 16 1931
Per cent split beans in grain	8.7	11 5	2 4	5 88	5 2	15.	3 22
Per cent loss in tailings or stack	No check	1 5	8 63	3 38	No check	No check	1 02
Condition for threshing	Excellent	Fair	Poor	Excellent	Good	Excellent	Good

An analysis of the results in the above table as it relates to combine operation confirms the opinion that the loss of beans in the pods which pass through the machine lessens as the number of cracked beans increases. It will also be noted that the regular bean thresher produced a considerable percentage of splits. Therefore, it would appear that both types of machines, the combine and the bean thresher need further mechanical improvements. The above table shows one test which should be given special consideration at this time. On March 16 of this year an improved grain thresher designed also for threshing beans was demonstrated near Flint. The comments of experienced threshermen on the performance of this improved grain thresher were very favorable. This test indicates that it may be possible to adapt the combine for threshing navy beans as well as small grains for which it was originally designed.

Weather Hazard

In the experimental tests, there have been no serious losses as a result of inclement weather although the beans were cured in windrows prior to threshing with a combine. However, there is danger of considerable losses during a normal year. Although the cost of stacking beans in the field will increase the harvesting and threshing costs, it nevertheless offers an insurance which may be of considerable importance.

Harvesting and Threshing Costs For Bean Thresher

Cost estimates for this machine as secured from the Farm Management Department of the College follow:

Man labor per acre	$3.29
Horse labor per acre	.81
Machinery cost per acre	.52
Threshing cost per acre	1.34
Miscellaneous	.22
Total harvesting and threshing cost per acre	$6.18

The value \$6.18 includes the cost of pulling and raking. The estimated per acre cost of pulling and raking is \$1.18; \$6.18 — \$1.18 = \$5.00, the per acre cost of harvesting and threshing navy beans less pulling and raking costs.

Cost of Combining Beans From the Windrow

There is at this time no definite information available on the cost of combining navy beans. Only estimates can be given after certain assumptions have been made. For example, it is to be assumed that in Michigan the combine is first a small grain machine and its major work will continue to be the threshing of small grains. Suppose for example, that the combine will harvest and thresh each year 156 acres of small grain. This amount is then supplemented by 23 acres of navy beans making a total of 179 acres. Since combine depreciation is greater in beans than in small grains, it is further assumed that the life of the combine is 7.3 years instead of 10 years for use in small grains only.

The total investment of combine including cylinder, reduction, gearing, and pickup will be approximately \$1800.00 for the ten foot machine.

Yearly overhead costs	\$416.00
Yearly combine and motor operating costs	70.80
Yearly tractor overhead and operating costs (10-20) H. P.	101.00
Yearly Total Cost for 179 Acres	\$587.80

$\frac{\$587.80}{179}$ = \$3.28, approximate cost per acre where combine is used for small grains as well as for beans. If used for beans only on small acreages, the cost for threshing from the windrow may exceed \$10.00 per acre.

BORERS SEVERELY INJURE FRUIT TREES

Vigilance Rather Than Expensive Methods Needed To Control These Insects

RAY HUTSON, SECTION OF ENTOMOLOGY

There are four wood-boring insects which, in the aggregate, cause a great deal of damage to Michigan fruit trees. These insects are the fruit tree bark beetle, the flat-headed apple tree borer, the peach borer, and the lesser peach borer.

Fruit Tree Bark Beetle

The ravages of the fruit tree bark beetle are well-known in many parts of the state, especially in the northern half of the western fruit belt. This pest attacks all fruit trees indiscriminately and is a source of loss on all varieties of tree fruits grown in the infested region. It also infests wild cherry and plum. It is sometimes called the shot-hole borer, and this name is extremely applicable, since the exit holes made by the adult beetles in emerging from the trunk of the tree after they have completed their damage is very suggestive of the effect of small shot on the trunk or limbs of the tree.

This pest, while it sometimes causes considerable damage to healthy trees, always breeds in trees which, because of weakness brought about by soil conditions, disease, or insect attack are in poor vigor. The insect attacks which may cause the lowered vigor and vitality of the trees sometimes in badly infested districts may include attacks of this beetle because repeated and long continued attacks by this insect in an effort to burrow into the bark causes the loss of so much sap from areas in the bark that they dry out and give the beetles a chance to establish themselves.

It is unnecessary to go into detail concerning the life history of this insect beyond pointing out that the adult beetles select trees which are in poor vigor from any of the causes named above and deposit eggs in small burrows made in the bark. The eggs hatch and the larvae tunnel all about in the inner layers of the bark, destroy the cambium, and cause the death of the tree.

The control of shot-hole borers requires vigilance. Immediate removal and destruction of all dead or dying fruit tree wood and wild cherry will result in the reduction of the fruit tree bark beetle. This method if carried out to the fullest extent, will eventually reduce the damage done by the beetle until it is inconsequential.

When orchards are pulled and the wood corded up for later consumption the piles form a very fine place for the entries of this pest. Dry wood has no attraction whatever for these insects.

Flatheaded Apple Tree Borers

Flatheaded apple tree borers are primarily a pest of young, unsprayed orchards. This is brought about by the fact that there is a tendency to leave trees severely alone beyond the usual routine practices of cultivating and pruning for a period of two or three years after they have been set out. This gives the flatheaded borers a chance, of which they often take advantage to the detriment of the trees. As many as one-half of the set of trees may be taken by this borer, and cases have been seen where practically all of the trees have been severely injured. A periodical inspection of young trees will do much to enable the recognition of damage before it has progressed to a point where treatment is no longer of any avail.

Dead and darkened areas on the trunk of the young tree indicate places where the insects are working, if there is no other indication such as sawdust visible externally. If such areas are excavated, a larva about an inch long with an extremely large head in proportion to its body will be found doing the work underneath the bark. In extreme

cases enough of these insects will attack a tree to girdle it and cause the death of the tree.

The control of flatheaded apple tree borer, as indicated by experiments during the past two seasons, can be brought about by the application of paradichlorobenzene as for the control of lesser peach tree borer. This material is applied by painting the infested areas with the solution. The application can be made any time that the weather is not too hot or the tree is not in a rapidly growing condition. Early spring and fall are good times for this work. The mixture consists of one pound of paradichlorobenzene dissolved in two quarts of raw cottonseed oil. This material should not be put on in such a way as to run down the trunk of the tree in any quantity, nor should it be put on in extremely hot weather. Any cultural practice which will have a tonic effect upon the tree will aid the tree to recover.

Lesser Peach Tree Borer

In the last two or three years, the depredations of the lesser peach tree borer in the limbs and trunks of peach trees have seemed to be on the increase all over the United States. While this pest is primarily one which attacks injured areas on the tree and works out from them, cases of extremely heavy infestation in perfectly healthy trees have occurred. There are a few cases in Michigan where the pest has been present in sufficient numbers to bring this about, but it is more commonly found in orchards where some injury, such as winter injury to the trunk of the tree, has occurred.

Experience during the past two seasons with artificial control has given very excellent results. The treatment consists of painting the affected area, after removing the gum and frass from the surface, with a solution of one pound of paradichlorobenzene in two quarts of raw cottonseed oil. The material is painted on the area and nothing further need be done.

Peach Tree Borer

The most important single insect at present affecting peach trees in Michigan is peach tree borer. The ravages of this pest are too well known to need description, but a sketch of the life history of the insect is in order to show the best time for treating for it. The adults of the peach tree borer begin to emerge during late May and continue through until sometime in September. During all this period, the females are depositing eggs on the crowns of trees. From this, it can be seen that the time from the standpoint of the life history for treating this insect will come sometime in the neighborhood of the first of September, because at that time the eggs have all been laid and hatched, the larvae are small, and little damage has been done by their feeding.

In the quarterly bulletin for February, 1931, a full description of the method of treating for the peach tree borer with paradichlorobenzene is given. Briefly it is to distribute the required dose about the base of the tree without otherwise disturbing it. The chemical is covered with soil, making a mound. The dose should be adjusted to the size of the tree, taking a six year old tree as the standard. An average

six year old tree will require a dose of about one ounce. Young trees up to four years old are susceptible to damage by this material and very great care should be exercised in treating them. In sandy soils the necessity for the removal of paradichlorobenzene after treatment does not exist. However, in heavier soils the danger to the tree necessitates the removal of the mound after about three weeks.

The control of these boring insects in fruit trees does not necessitate any marked outlay for spraying materials, nor the expenditure of any large portions of the orchardist's time. It does, however, necessitate constant vigilance and the carrying out of these operations at the proper time. The operations advised for the control of shot hole borer are good sound agricultural practices, anyhow. The returns from an effort to eliminate the wood-boring insects affecting fruit trees will be more evident than that resulting from an equal expenditure of time on any other orchard operation. This is especially true in the case of the peach tree borer, since this pest results in the death of many trees and the shortening of the productive period of those remaining.

MICE, TREES, AND FREEZES

Rodent Control Should Not Be Allowed to Induce Winter Injury

F. C. BRADFORD, SECTION OF HORTICULTURE

Eagerness to overcome one difficulty may lead to exposure to another. Sometimes field mouse control has been achieved at the cost of winter injury to the trees which were saved from mice. Ordinarily, naturally and properly, mounding and wrapping are done when apple picking is finished. Unfortunately, however, these operations often involve clearing grass away from the trees, and grass is often removed just before the ground freezes.

Grass in the orchard tends to check tree growth and to ripen the wood but when it grows close to the tree trunk it keeps the bark of the lower trunk moist and retards ripening at that point. As compensation, during the winter it acts as a protection and trees standing in sod are not very likely to suffer from collar injury. When, therefore, grass is removed in late October and early November, the tree is left in susceptible condition and deprived of protection, thus doubly inviting injury.

This is not necessary. If grass is not removed until late fall, the protection afforded by a six-inch mound of sandy loam will in large measure offset the exposure of unripened tissue, besides increasing the protection against mice. The more sand there is in the soil used

for mounding the better, as there is less likelihood of the swaying of the tree leaving permanently a space around the trunk.

A better course, however, is to remove the grass in early or mid-September, whatever the subsequent method of mouse control to be adopted. This permits the ripening of the tissues at the collar before there is danger of injury from freezing. What grass may grow between this time and late October does not ordinarily retard ripening and is easily removed just before cold weather sets in. If the grass removal is done early, mounding can still be practiced, and, if mounding is not done, the trees are safer against injury.

Mounding itself, however, should not be done until late fall. If done early, it retards ripening of the collar even more effectively than the grass, and early mounding is only one degree less injurious than late grass removal. The same principle, of course, applies to veneer and paper wrapping.

HARVESTING MICHIGAN'S ALFALFA SEED CROP

Growers Tell Methods Used to Prevent Losses Through Shattering

P. R. MILLER, SECTION OF FARM CROPS

"Handle the alfalfa seed crop during harvest as carefully as you would handle eggs," is the statement of one Michigan grower, and anyone who has had anything to do with the crop will agree that he isn't far wrong.

With high quality alfalfa seed worth from 30 to 45 cents per pound, shattering is costly and methods followed to reduce this shattering to a minimum will result in a real saving to the growers. With a view to determining the practices followed by Michigan farmers in the harvesting of the alfalfa seed crop, a questionnaire was sent to over 100 leading certified alfalfa seed growers. Some of the information obtained from this survey follows:

Time of Cutting

80 per cent harvest when pods are from 2/3 to 3/4 brown.
20 per cent harvest when all pods are dead ripe.
85 per cent cut in early morning while dew is on.
15 per cent cut afternoon, evening, or anytime.

Crop for Seed

90 per cent harvest seed from first crop year in and year out.

Method of Harvesting

58 per cent use mower with windrow or pea attachment.
28 per cent use grain binder.
11 per cent use mower and side delivery.
3 per cent use a reaper.

Method of Curing in Field

50 per cent leave crop in bunches in field.
28 per cent leave crop in shocks in field.
18 per cent leave crop in windrow in field.
4 per cent leave crop in swath in field.

Condition of crop After Cutting

The majority experienced little difficulty in the crop coiling or hanging together during or after cutting except in cases where the growth was exceptionally rank. Small to medium size bunches which permitted the bunch to be loaded in one forkful, thus minimizing loss from shattering, were preferred.

Precaution to Recover Shattered Seed

The majority use tight bottom racks, covered with canvas or building paper to catch seed that shatters during hauling and hulling. One grower uses side boards on his wagon, another a bed of straw on the rack bottom. Shattering was most common during hauling and hulling, rather than during harvesting and handling, as might be expected.

Methods of Handling

70 per cent thresh from field.
24 per cent thresh from barn.
6 per cent thresh from stack.

Methods of Hulling

80 per cent thresh with clover huller, large size preferred.
20 per cent thresh with grain separator.

Rethreshing Stacks

Only 10 per cent had ever rethreshed.

Following are several examples of the results obtained from rethreshing.

Bushels 1st threshing	Bushels 2nd threshing	Kind of machine 1st threshing	Kind of machine 2nd threshing
12	3½	Separator	Separator
18	2	Separator	Separator
90	8	Separator	Huller
6	None	Huller	Huller
153	5	Separator	Separator

In general, the opinion was expressed that rethreshing is unnecessary if proper equipment is used, is in good condition, and is operated correctly.

Cultivating Seed Fields

52 per cent cultivate their alfalfa seed fields.
48 per cent do not, but a number signified intentions of doing so.
90 per cent cultivate fields in spring.
10 per cent cultivate fields after the crop is off.

The majority use a spring tooth drag. The quack grass harrow, field cultivator, and spike tooth were frequently mentioned.

FIND PROMISING GRAPE VARIETY FOR LOCAL MARKETS

Campbell Early Produces Good Yield of Attractive, High Quality Fruit

NEWTON L. PARTRIDGE, SECTION OF HORTICULTURE

A study of the fruiting habits and pruning of the Campbell Early grape (Mich. Agr. Exp. Sta. Tech. Bul. 106) shows that this variety may be very productive when grown on very fertile soils. Some idea of its productiveness may be obtained from the yields harvested from the most satisfactory of the pruning plots. The annual yields, in tons per acre were: 1926, 4.5; 1927, 2.7; 1928, 5.7; 1929, 5.3 and 1930, 5.6 tons per acre net weight. The average annual production was 4.7 tons per acre over a five year period. Comparatively few Concord vineyards in Michigan have produced as much fruit during this period.

Many of the plantings of Campbell Early were made on the wrong type of soils and have been unsuccessful. The variety has not succeeded on sandy soils of low fertility which produce weak, unproductive vines of the type shown in Figure 1. Those soils which are suited to the growth of the Campbell Early grape are high in fertility and the vines should be given frequent manuring with organic fertilizers as well as some ammonium sulphate or nitrate of soda each year. The soils which have produced high yields are sandy or silt loams which are usually called clays by the growers. The soil must not be so compact that it interferes with drainage or the penetration of the roots. When the soil is satisfactory the vines produce well and make a good growth, as is shown in Figure 2.

When well grown the Campbell Early grape produces exceptionally large bunches of large black berries. The bunches frequently weigh as much as a pound and sometimes as much as a pound and a half. The quality is excellent though the fruit is somewhat more acid than Concord. One of the objections to this variety is that it appears to be mature before the fruit is fully ripe. The bunches should be permitted to hang on the vines until mature, which will be only a short time before Concord is ready to harvest. The bunches will hang on the vine with little loss for some time after they have matured so that

Fig. 1.—Fruit production on a weak Campbell Early vine, only a few scraggly bunches are developed. This vine is on an infertile sandy soil and has been underpruned.

the picking season is a long one. Owing to the size of the bunches it is difficult to pack this variety in small covered baskets and it is rather difficult to pack 12-quart baskets so that the surface is smooth. When sold at a roadside market or locally, the baskets should be left uncovered with the bunches exposed. Baskets packed in this way are very attractive and should sell at a premium over Concord.

Campbell Early is a variety that demands greater skill on the part of the grower than does Concord. The vines should not be permitted to carry more than two-thirds as many buds as Concord. When carelessly pruned, the vines will often overproduce and it takes two or three years to bring them back to good production. The grower must watch the vines closely, and if too large a crop is set the bunches should be thinned. Large bunches are produced on vigorous growth

and poor scraggly bunches on weak growth; consequently, the largest canes on these vines should be saved at pruning time, even though they are over three-eighths of an inch in diameter. About 15 buds should be left on each cane at pruning time. Since the Campbell Early is less vigorous than Concord under similar conditions and as it should only have about two-thirds as many buds left on it as on the Concord, there should usually be but two or, if the vine is very vigorous, perhaps

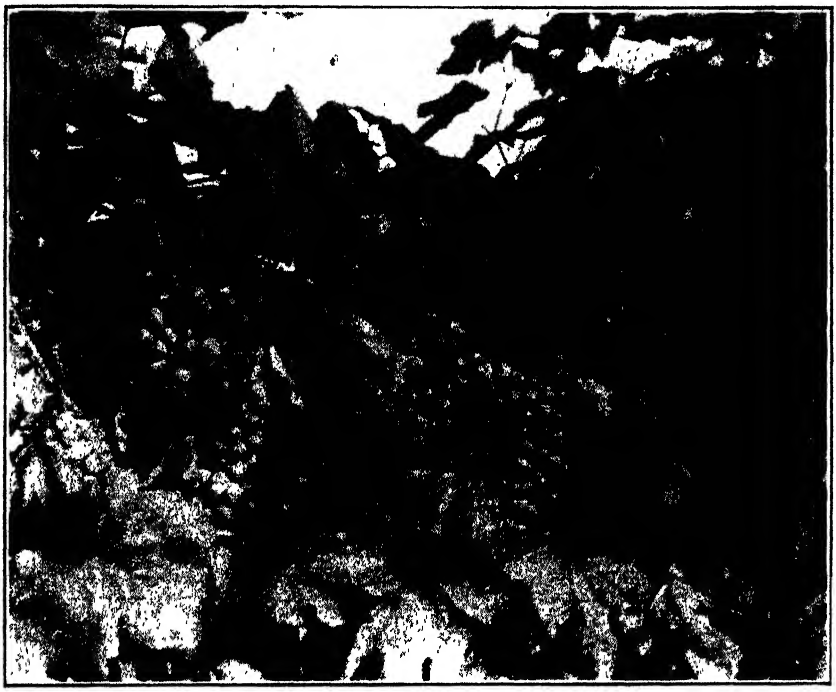


Fig. 2.—Fruit production on a vigorous Campbell Early vine. This vine is on a loamy soil, has been fertilized regularly, and was pruned to 40 buds.

three canes left. Spurs may be left on arms where no canes are needed. Owing to its lack of vigor, Campbell may well be planted eight feet apart in ten-foot rows.

There are marked differences between Concord and Campbell Early. Campbell Early demands a richer soil and more fertilization than does Concord. At pruning time, Campbell Early should be pruned more severely than Concord vines of equal vigor, the Campbell Early being pruned to about two-thirds the number of buds left on Concord vines as shown in the pruning schedule given in the revised edition of Special Bulletin 141. The best canes on Concord are about a quarter of an inch in diameter, but the larger the cane on Campbell Early the better the yield. Canes three-eighth of an inch or more in diameter were much more productive than quarter-inch canes. Campbell Early canes produce best when left with about 15 buds.

WHITE PINE WEEVIL IS INCREASING IN MICHIGAN

Reforestation Plantings May Be Protected by Interplanting Hardwoods in Pine

EUGENIA I. McDANIEL, SECTION OF ENTOMOLOGY

The most destructive insect enemy of white pine, in the northeastern United States, is the white pine weevil *Pissodes strobi.* This beetle is to be found wherever white pine grows and, while it attacks a number of other conifers, the white pine remains first choice. In Michigan,

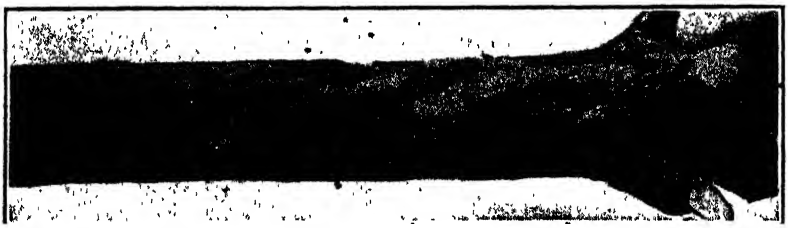


Fig. 1.—Leader of white pine infested with white pine weevil. With bark partially cut away. Slightly enlarged.

this weevil has been secured from white pine, Jack pine, and Norway spruce. Doubtless further investigation will reveal additional host plants, for it is the belief of entomologists that all pines and spruces are susceptible when the weevil is present in numbers. Hemlock, arborvitae, and balsam fir are apparently immune.

Fig. 2.—Leader of white pine infested with white pine weevil, showing exudation of pitch from feeding punctures.

The white pine weevil is rapidly becoming an important insect in Michigan. The present reforestation movement in the State leans heavily toward white pine and these recently set trees are now at the most susceptible stage, since the beetle prefers trees from 4 to 15 or 20 feet in height, grown either in pure stands or as isolated trees in ornamental plantings.

The adult is a small snout-beetle measuring about one-fourth inch in length, reddish-brown in color, and irregularly marked with white or cream colored scales.

There is one annual generation, the adults wintering over in trash and duff at the base of the tree. They become active about the time the buds begin to swell in the spring. Development from the egg to the adult requires about three months. The females ascend the trees, and on reaching the terminal leader begin to deposit eggs in last year's growth. A cavity is hollowed in the cambium and from one to three eggs are deposited in each cavity. Each female is capable of laying a hundred or more eggs in a lifetime.

The eggs hatch in from one to two weeks and the young start working downward through the cambium. The larvae reach maturity in about two months. Before pupation each larva cuts a deep hole or pupal chamber, which is lined with chewings, in the wood. Here pupation takes place. Only 10 days or two weeks is required for the pupae to develop. The adults begin appearing in August.

The white pine weevil works only in the terminal growth, never in the trunk or at the base of the tree. Resinous exudations on last season's growth indicates the presence of eggs. Withered brown dying tips in midsummer are characteristic of weevil attack.

Trees ranging from 3 to 15 feet in height are most severely injured. Where the terminal is killed, a lateral branch will turn upright and take the place of the injured leader. Trees so affected develop abnormally and their value for lumber is reduced.

Control

The white pine weevil has been recognized as a problem for over a hundred years. To date, the most practical silvicultural control consists in interplanting white pine with hardwoods in reforestation projects.

The beetles sometimes reach the terminals by crawling up the tree, but they are very capable fliers. They are known to fly for long distances and frequently drift with the wind. They settle on terminal growths in the full sunlight where they feed and deposit eggs, the distance they fly above the earth seeming to depend on the height of vegetation. They select only the highest pine trees in the area for egg laying and consequently where white pines are grown under a nurse crop of hardwoods, the range of the beetles flight is raised above the terminal growth of white pine.

White pine ceases to be susceptible to the weevil after it reaches the height of 20 feet.

Where white pine plantations are made in pure stands, the trees should be planted close together, since they suffer less injury than trees grown in widely spaced stands. The planting of mixed stands of conifers is to be encouraged, care being taken to select varieties

believed to be least susceptible, such as white spruce and red pine or a rapid-growing, quick-maturing variety like Scotch pine. Where white pine is interplanted with Scotch pine, the latter outstrips the former in a few years and is ready to be cut by the time the white pine has matured beyond the stage where it is susceptible to beetle attack.

There are a number of natural enemies of the white pine weevil and when infested terminals are cut from the trees they should be placed in a tight barrel or keg, over the end of which is a close-fitting screen cover of mesh such as is used in ordinary window screen. This keeps the beetles in but lets the parasites escape to attack new colonies of white pine weevil.

Hand picking adults or collecting them with insect nets from small trees has been recommended. Britton and Walden* have carried on experiments which indicate considerable injury can be prevented if the leaders are sprayed with lead arsenate at the proper time.

White pines are annually subject to infestation wherever it is possible for the beetles to come in from adjacent plantings. Weather conditions and direction of the wind play important parts in each infestation. The beetle is inactive when the temperature is below 70° F. or above 85° F. If the prevailing winds blow from infested trees to uninfested trees during May or June, infestation is probable.

TEST EFFECT OF STARTER ON KEEPING QUALITY OF BUTTER

P. S. LUCAS, C. D. BALL, R. E. VINCENT, AND G. M. TROUT,
SECTION OF DAIRY HUSBANDRY

The use in buttermaking of bacterial cultures of the lactic acid group was introduced by the Danish scientist, Storch, in the 90's of the past century. Used for the development of flavor and aroma, there has resulted considerable difference of opinion among creamery men as to their value and their effect on the keeping quality of the resulting butter. One of the leading butters on the world market, that from Denmark, is made from sweet cream ripened to a low degree of acidity by the use of starter. A second butter, very popular, is made in the United States, from sweet cream only, no starter being used.

The bulk of experimental work to date favors the use of sweet cream in buttermaking so far as keeping quality is concerned. This includes the work of Curtis, Patrick, Dean, Gran, Charron and Shult, Rogers, Thompson and Keithley, Mortensen, and White. Much butter is consumed in a fresh state, however, and the use of starters has continued because there is still a question as to the comparative values of sweet cream and starter butter. Many practical conditions enter into the

*Britton, W. E. and Walden, B. H.—Conn. Agr. Exp. Station Report, 1912, pp. 307-3.

consideration as well, which it is not in the province of this article to discuss.

As a means of determining the effects of varying procedure in buttermaking, lots of sweet cream were divided into five portions. One portion was churned sweet; the second was churned sweet, but 3 per cent of its fat weight was added with the salt in the form of starter; a third was churned, after 3 per cent of the cream's weight in the form of starter was added just before churning; a fourth was ripened to .3 to .35 acidity and churned; the fifth was ripened to .45 to .52 acidity and then churned. The starter used was that of a culture of high flavor and low acid producing bacteria supplied by the Iowa Experiment Station. The conditions under which each was churned were identical. Samples were taken from each churning, marked for identification, and stored at 0° F., and used for scoring and chemical analysis. Each sample was scored after a storage period of a day, one week, one month, three months, and six months.

Scores were checked against the following chemical tests; amino nitrogen and total nitrogen content, the acid number, iodine number, Reichart-Meissl number, and the Kreis test. At the end of the six months storage period each sample was tested for the presence of trimethylamine, the product thought to be responsible for the presence of "fishiness." The buttermilk was tested for per cent fat, and the butter for percentages of per cent fat, water, salt, and curd. The term curd, as used here, refers to physiological curd, and percentage curd as the figure obtained by the subtraction from 100 of the sum of the percentage of fat, salt, and water, rather than a figure obtained by the multiplication of the nitrogen by 6.38.

Inasmuch as curd content has been thought to play an important role in keeping quality of butter, it is interesting to note that it apparently had little, if any, influence in these experiments, for of the 12 series of tests the curd content varied very constantly between .95 to 1.1 per cent, no matter which of the methods of churning used. It was concluded, therefore, that even the working of starter into butter had practically no effect on the curd content and that this had no effect on deterioration of quality in these trials.

The amino nitrogen content showed fluctuations in the different samples but these were so small as to have no significance. The sweet cream butter contained a slightly lower nitrogen content than did the butter made from ripened cream. The nitrogen content appeared a trifle higher after storage for three months. The values obtained by the Reichart-Meissl test fell within the ordinary values obtained by other workers, showing no relation to the methods used, but decreased slightly as the storage period lengthened. The iodine numbers increased during storage but likewise showed no relationship to the use of starter. An increase in the acidity of the cream seemed to cause a slight increase in the acid number of the butterfat. The Kreis test alone showed a relationship to score. Being qualitative only, no measure of the amount of oxidation is given. However the butter scoring lowest showed greatest increase in the average value while that scoring highest showed no increase.

In the fresh state, that is after one day of storage, the average score of the butter made from cream ripened to .3 of 1 per cent acidity

scored highest. This average score was followed closely, in the order named, by that of the butter which had starter added to the cream at the time of churning, that to which starter was added just before working, that ripened to .45 acidity, and by the sweet cream butter. The differences in these average scores were not great for the fresh butter, but increased in magnitude as the storage period lengthened. The range in score between the highest and lowest was 1.53 points when the samples were scored in a fresh condition. As compared with the best starter butter, that made from sweet cream lacked flavor to a degree. That sample ripened to .45 acidity, scoring fourth, carried an undesirable amount of acid flavor.

When scored after 30 days of storage the placings were considerably different. Butter from the lot of cream having starter added to the cream at the time of churning placed first, that to which starter was added just before working placed second, the .3 acidity cream scored third highest, the sweet cream butter fourth, and the butter made from cream ripened to .45 acidity last. During 30 days of storage, this last named sample decreased in average score 1.7 points. The sample placing first had decreased in average score but .7 of a point, the sweet cream butter .9 of a point. The usual off flavors were beginning to appear in some of the samples, and these were beginning to show themselves especially distinctly in the samples made from cream ripened to .45 acidity. These were characterized as unclean, tallowy, and with an occasional suggestion of fishy flavor.

After three months of storage, the average scores of the butter to which starter was added to the cream at the time of churning were still highest. It was still very excellent butter, the score having decreased during storage but 1.1 points. This butter would still have sold as extras. Of almost equal quality was the sample having starter added to the butter before working, the average score being about one-half point lower. The sweet cream butter placed third, the reduction in score amounting during storage to 1.5 points. This butter in about 50 per cent of the cases was beginning to assume a slight oxidized taste not resembling rancidity but rather the taste of tallow. The average score of the ripened cream butter were very low after three months of storage. That made from cream ripened to .3 acidity had decreased 4.5 points in score, and that from cream ripened to .45 acidity had decreased 4.1 points. Many samples had, at this time, developed a slight fishy flavor and at the end of six months practically all in these two series had become fishy. Tests at the end of the six months period showed the presence of trimethylamine in these samples.

It should be understood that the ripened cream butter in these experiments is not necessarily comparable to the ripened cream butter made in the usual creamery, for these samples were ripened from pasteurized sweet cream using a pure lactic acid culture. The results show, however, that even under ideal conditions, it is unwise to ripen cream, even moderately, if the butter is to be put into storage for any considerable period. It would further appear that the addition of a moderate amount of starter to cream before churning or to the butter at the time of working caused the butter to score somewhat better after a three months storage period than if none had been used. Whether the aroma due to the starter covered the slight off flavors that

normally develop in sweet cream butter during storage or whether some inhibitory action took place when starter was used, the authors are unable to say.

A year after these results were secured the churnings were repeated, the samples of butter being sent to the Chicago market for scoring, when fresh, and after 30 days, and 180 days of storage respectively. The chemical analysis of each was omitted in this series and the starter was added in the amounts shown in the Table, but otherwise the procedure was the same as described. The scores received are given in the following tables.

Table 1.—Showing flavor scores of three samples of butter at intervals after churning.

Age of butter	Sample number				
	1	2	3	4	5
	Sweet cream	5% Starter to cream	5% Starter to butter	Ripened .32% acid	Ripened 45% acid
Fresh	36 0 35 0 35 0	35 5 36 0 34 5	35 5 36 0 33 5	34 0 35 5 35 0	34 0 33 0 33 0
Average	35 33	35 33	35 0	34 83	33 33
30 days	34 0 34 0 32 0	34 0 34 5 33 0	34 0 34 0 32 0	32 0 34 5 32 0	32 0 32 0 32 0
Average	33 33	33 83	33 33	32 83	32 0
180 days	35 0 33 0 33.0	35 0 33 5 34 0	34 33 5 33.0	32 0 32 0 34 0	31 0 30 0 31 0
Average	33 67	34 17	33 5	32 67	30 67

The tendency of these samples to deteriorate during storage approximated very closely the samples previously discussed. At the end of both the 30 day and 180 day storage period, the samples to which starter had been added immediately before churning scored higher than the butter made from sweet cream. Ripened cream in these instances also, when churned, gave butter of poor keeping qualities.

As may be seen from the table, the ripened cream butter deteriorated more rapidly during storage than the other three samples. Though it may not be said that sweet cream butter lost in flavor more rapidly during storage than the samples having starters added at the churn, neither may it be said that the latter had their keeping qualities reduced by the addition of starter.

MAKE STUDY OF RICKETS IN CALVES

Sunshine Counteracts Deficiencies in Rations Which Would Cause Disease

C. F. HUFFMAN, SECTION OF DAIRY HUSBANDRY

It is common observation that calves under ordinary farm conditions seldom show the symptoms of rickets such as bowed legs, stiff gait, and emaciated appearance. However, this disease often occurs among pigs, chickens, and puppies during the winter months unless the ration is supplemented with the mineral retention vitamin or the animals are treated with ultra violet light.

Rickets is a disease of the growing bone, due to one or a combination of the following factors:

1. Low calcium in the ration.
2. Low phosphorus in the ration.
3. Low calcium and phosphorus in the ration.
4. Improper relation of calcium to phosphorus.
5. Deficient vitamin D in the ration.
6. Insufficient ultra violet light.

During the winter months in Michigan, sunshine does not furnish sufficient ultra violet light to prevent rickets in most animals. Consequently, the antirachitic factor should be furnished in the feed or by ultra violet light irradiation.

The results of most investigators indicate that cattle unlike pigs, chickens, puppies, and rats are not able to use sunshine. Calves grown in the dark and fed ordinary rations did just as well as those allowed sunshine.

The Dairy Section in cooperation with the Section of Experiment Station Chemistry are making a study of the mineral metabolism of dairy cattle. Preliminary results indicate that calves require vitamin D, the mineral retention factor. Calves fed a basal ration low in this vitamin and kept from sunlight developed rickets (see Fig. 1), while calves fed the same ration and turned into an open lot where they were exposed to the sun were normal (see Fig. 2). Calves fed the basal ration supplemented with cod liver oil and kept away from sunlight did not manifest the symptoms of rickets (see Fig. 3). This indicates that calves are able to use the vitamin D in cod liver oil.

In this investigation, the addition of two pounds of sun-cured timothy hay per day prevented the onset of rickets in calves fed the basal ration

Fig. 1.—Showing rickets in Calf C 106, fed a basal ration low in vitamin D. This calf did not receive sunshine.

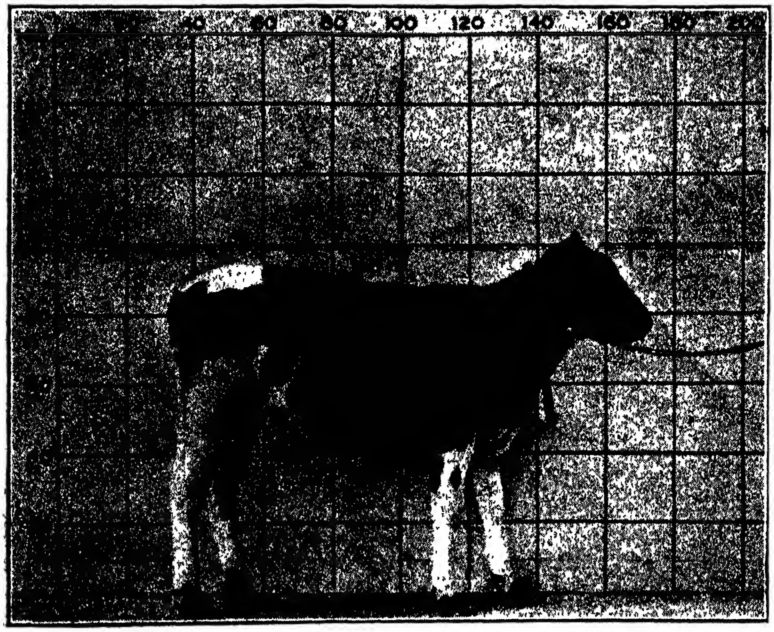


Fig. 2.—Calf C 111. Showing the rickets-preventing power of sunshine. This calf received the same ration as C 106 shown in Fig. 1, except that it was exposed to sunshine.

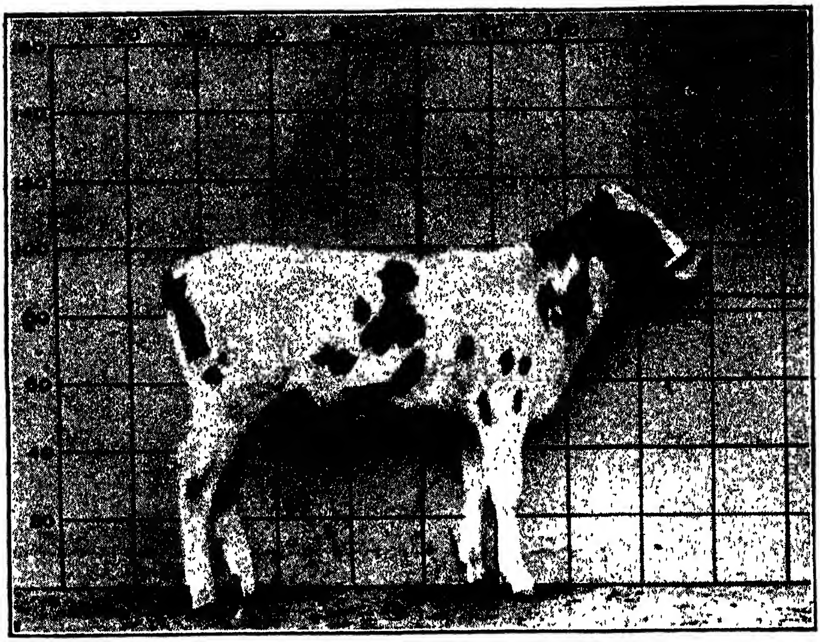


Fig. 3.—Calf C 110. Showing antirachitic effect of supplementing the basal ration with cod liver oil. This calf did not receive sunshine.

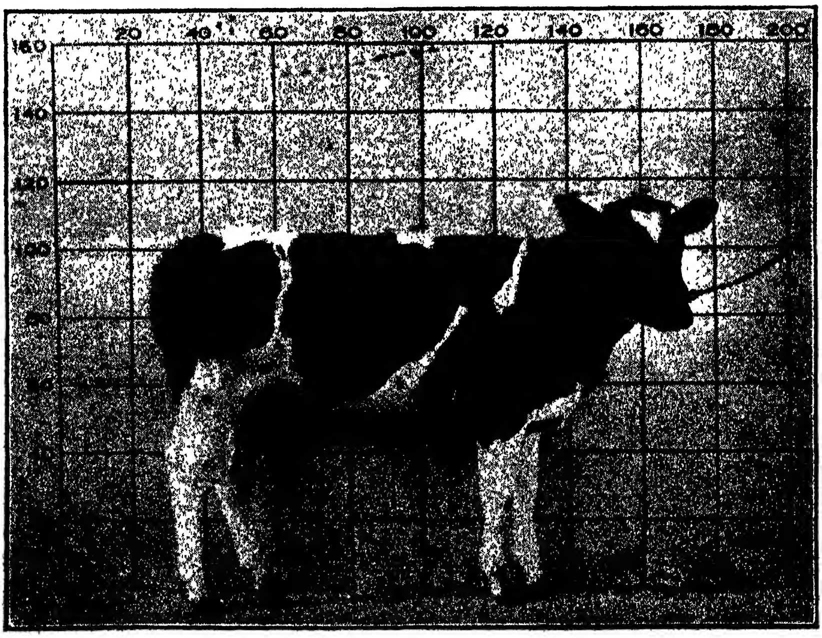


Fig 4.—Calf C 100. Received the basal ration supplemented with two pounds of hay cured in the sun. This calf did not receive sunshine. It was normal in every respect.

and kept away from the sun (see Fig. 4). It is likely that such hay is the principal source of vitamin D for dairy cattle during the winter months. These results also explain why calves under ordinary farm conditions fail to show rickets during the winter. Calves begin to eat hay at an early age which probably furnishes sufficient vitamin D for normal growth and for the prevention of rickets.

MAKE TESTS OF RATIONS FOR LAMBS

Animals Fed Give Good Returns For Feed Consumed

G. A. BROWN, SECTION OF ANIMAL HUSBANDRY

One hundred thirty western feeding lambs averaging 62 pounds in weight were purchased on the Chicago market November 7, 1930, costing $7.00 per hundredweight in Chicago. These lambs were fed on alfalfa hay until November 8, when the first of three initial weights were taken and the lambs divided into eight lots of sixteen each.

The lots were as near equal as it was possible to get them from the standpoint of weight, form, condition, quality, sex and feeding capacity. Two lambs were slaughtered and an autopsy conducted. The lambs showed a heavy lung worm infestation and a few tapeworms and had been given the black-leaf forty, copper sulphate treatment before going on feed.

Native medium wool lambs were purchased on the Detroit market November 18 costing $6.00 per hundredweight. These lambs were far superior to the average run of native lambs in health, uniformity, and breeding. Fine wool lambs were purchased at Detroit November 24 and like the medium wool lambs were a superior group.

The object of this test was to study the comparative feeding values of:

1. Corn versus barley; Lots 2 and 6.
2. Corn versus oats; Lots 2 and 7.
3. Barley versus oats; Lots 6 and 7.
4. Alfalfa hay versus silage and alfalfa; Lots 1 and 2.
5. Linseed meal versus no protein supplement; Lots 2 and 3.
6. Oats with and without a protein supplement; Lots 4 and 7.
7. Amount of protein supplement to feed with oats; Lots 4 and 5.
8. Corn versus oats versus wheat, each fed with a protein supplement; Lots 3, 4, and 8.
9. **Western range lambs versus native lambs; Lots 3, 9, and 10.**

Rations fed:

Lot 1. Alfalfa hay, shelled corn.
Lot 2. Alfalfa hay, shelled corn, silage.
Lot 3. Alfalfa hay, shelled corn 7 parts, linseed meal 1 part, silage.
Lot 4. Alfalfa hay, oats 7 parts, linseed meal 1 part, silage.
Lot 5. Alfalfa hay, oats 14 parts, linseed meal 1 part, silage.
Lot 6. Alfalfa hay, barley, silage.
Lot 7. Alfalfa hay, oats, silage.
Lot 8. Alfalfa hay, wheat 7 parts, linseed meal 1 part, silage.
Lots 9 and 10. Fed the same ration as Lot 3.

First cutting alfalfa hay of fair quality was fed throughout the test. At the beginning of the test, each lot of lambs, was receiving four pounds of grain, four pounds of silage, and 36 pounds of hay daily except Lot 1 which did not receive silage. The grain allowance for all lots was increased to one pound per head daily at the end of two weeks, to one and one-fourth pounds per head daily at the end of four weeks.

When on full feed, or six weeks after starting on feed, the average daily ration per lamb for each lot was approximately as follows:

Lot 1. 1.37 lbs. grain, 1.71 lbs. hay.
Lot 2. 1.5 lbs. grain, 1.44 lbs. hay, 1.0 lbs. silage.
Lot 3. 1.75 lbs. grain, 1.20 lbs. hay, 1.25 lbs. silage.
Lot 4. 1.75 lbs. grain, 1.08 lbs. hay, 1.25 lbs. silage.
Lot 5. 1.75 lbs. grain, 1.04 lbs. hay, 1.25 lbs. silage.
Lot 6. 1.75 lbs. grain, 1.08 lbs. hay, 1.00 lbs. silage.
Lot 7. 1.68 lbs. grain, 1.00 lbs. hay, 1.00 lbs. silage.
Lot 8. 1.62 lbs. grain, 1.31 lbs. hay, 1.00 lbs. silage.
Lot 9. 1.75 lbs. grain, 1.20 lbs. hay, 1.25 lbs. silage.
Lot 10. 1.50 lbs. grain, 1.02 lbs. hay, 1.00 lbs. silage.

All lots receiving linseed meal in the ration consumed their feed more readily, ate somewhat more feed, and were not as inclined to go off feed as those lots which did not receive linseed meal.

Lot 8 was fed wheat only the first three weeks during which time they gained very slowly and had poor appetites for the wheat. The addition of linseed meal to the ration resulted in better appetites and faster gains. At no time did the lambs fed wheat and linseed meal gain as rapidly or eat as heartily as did the lambs fed corn and linseed meal.

All lots were fed to make approximately the same total gain per lot. Lots 2, 3, 4, 5, 6, and 9 were fed 85 days; Lot 9, 71 days; and Lots 1, 7, 8, and 10, 98 days.

Summary of lamb feeding trials conducted winter 1930-1931.

*	Lot I	Lot II	Lot III	Lot IV	Lot V	Lot VI	Lot VII	Lot VIII	Lot IX	Lot X
	Shelled corn, Alfalfa hay Nov. 14 Feb. 20	Shelled corn, Alfalfa hay, Corn silage Nov. 14 Feb. 6	Shelled corn, Alfalfa hay, Corn silage, Linseed meal Nov. 14 Feb. 6	Oats, Alfalfa hay, Corn silage, Linseed meal Nov. 14 Feb 6	Oats, Alfalfa hay, Corn silage, Linseed meal Nov. 14 Feb. 6	Barley, Alfalfa hay, Corn silage Nov. 14 Feb. 6	Oats, Alfalfa hay, Corn silage Nov. 14 Feb. 20	Wheat, Alfalfa hay, Corn silage, Linseed meal Nov. 14 Feb. 20	Ration same as Lot III Nov. 28 Feb. 6 Native Medium Wool Lambs	Nov. 28 Feb. 20 Native Fine Wool Lambs
Number of lambs	16	16	16	16	16	16	16	16	20	20
Average initial weight	62 3	62 1	62 3	62 8	62 4	62 4	62 6	62 4	59 8	58 5
Average final weight	92 98	93 06	97 81	94 50	94 13	93 61	93 14	95 11	92 90	87 32
Average gain per lamb	30 73	30 94	35 5	31 75	31 69	31 17	30 52	32 73	33.10	28 82
Average daily gain per lamb	.314	364	418	374	373	367	311	.334	.466	.343
Average daily ration:										
Alfalfa hay	1 667	1 398	1 419	1 338	1 293	1 307	1 224	1.300	1 357	1 189
Corn silage		1 003	1 095	1 111	1 111	1 003	1 002	.982	1 054	1 013
Shelled corn	1 218	1 252	1 219						1 133	1 071
Oats				1 222	1 304		1 421			
Barley						1 383				
Wheat								1 193		
Linseed meal			.174	175	093			.136	.162	.153
Feed consumed per cwt. gain:										
Alfalfa hay	531 62	384 04	339 79	358 07	346 94	356 33	393 20	389 15	291 09	346 69
Corn silage		275 45	262 24	297 54	298 13	273 41	321 83	294 16	226 06	295 25
Shelled corn	388 35	343 94	291 85						243 02	312 16
Oats				327 17	349 68		456 17			
Barley						377 08				
Wheat								357 25		
Linseed meal			41 73	46 73	24 97			40 79	34 70	44 59
Feed cost per cwt. gain—Total	$7 56	$6 86	$6 81	$7 50	$7 26	$7 06	$8 29	$7 91	$5 74	$7 22
Initial cost per cwt. in lots	$7 40	$7.40	$7 40	$7 40	$7 40	$7 40	$7 40	$7 40	$6 30	$6 30
Initial cost per lamb in lots	4 61	4 60	4 61	4 64	4 62	4 62	4 63	4·62	3 77	3 69
Feed cost per lamb	2 32	2 12	2 42	2 38	2 30	2 20	2 53	2 59	1 90	2 08
Cost of lamb plus feed cost	6 93	6 72	7 03	7 02	6 92	6 82	7 16	7.21	5 67	5 77
Necessary selling price in lots per cwt	7 45	7 22	7 19	7 43	7 35	7 29	7 69	7 58	6 10	6 61
**Selling price in lots	8 00	8 00	8 00	8 00	8 00	8 00	8 00	8 00	8 00	7 50
Selling price per head	7 44	7 44	7 82	7 56	7 53	7 49	7 45	7 61	7 43	6 55
Returns per lamb above feed cost	.51	.72	79	54	61	.67	29	.40	1 76	.78

*Prices of feeds:
All grains $1.12½ per cwt. (corn 63c., barley 54c , oats 36c per bu) Alfalfa hay $12 00 per ton, Silage $5 00 per ton and Linseed meal $40 00 per ton.
**Selling price in Detroit less expenses and shrink—$1 10 per cwt.

Conclusions

1. The addition of corn silage to a ration of shelled corn and alfalfa hay increased the rate of gain and reduced the cost per pound gain. Lots 1 and 2.

2. The addition of linseed meal to a ration of shelled corn, alfalfa hay and corn silage, resulted in more rapid daily gains and a slight reduction in costs of gains. Lots 2 and 3.

3. The addition of linseed meal to a ration of oats, corn silage, and alfalfa hay increased the daily gains and reduced the cost per hundredweight of gain. One-fifteenth part by weight of linseed meal proved as efficient as one-eighth part. Lots 4, 5, and 7.

4. A ration of barley, corn silage, and alfalfa hay proved nearly equal in all respects to a ration of shelled corn, silage, and alfalfa hay. Either of the above rations produced more rapid and economical gains than did a ration of oats, corn silage, and alfalfa hay. Lots 2, 6 and 7.

5. A ration of wheat, 7 parts; linseed meal, 1 part; corn silage; and alfalfa hay did not produce as rapid or economical gains as similar rations containing either corn or oats. Lots 3, 4, and 8.

6. Native medium wool lambs gained more rapidly at a lower cost per hundredweight than did western range lambs. Lots 3 and 9.

7. Native fine wool lambs did not gain as rapidly or as economically as either native medium wool or western range lambs. Owing to the lower initial cost the native fine wool lambs gave approximately the same return above feed cost as the range lambs. Lots 3 and 10.

Judging from the returns made by the lambs fed in these trials fattening lambs offer a remunerative market for the surplus farm grains and roughages. Though wheat was not equal to corn in this trial the returns from feeding the wheat were well above the present market price for which wheat is selling. The western lambs costing $7.40 per hundredweight in the feed lot and selling at $8.00 per hundredweight in the feed lot gave a satisfactory return per lamb after paying for all feeds at prices higher than the present market offers. The native medium wool lambs, because of their lower cost and rapid gains, gave a higher return than any other lot.

With the present low market for lambs and the large supplies being offered, thin underweight lambs are meeting with sharp discrimination from the buyer and selling at a severe discount as compared with the finished lamb.

Producers are urged to finish their lambs, thus marketing hay and grain and giving the public a quality article for which a more remunerative price is received.

BULLETIN REVIEWS

Cir. Bul. 136.—HARDY PERENNIALS FOR LANDSCAPE PLANTING IN MICHIGAN.—Halligan, C. P.—This bulletin includes the consideration of the culture and use of hardy perennials for beautifying the home grounds with a description of each of the more desirable kinds of hardy perennials supplemented by tables of hardy perennials for special purposes.

This bulletin supplements the list of other bulletins previously published on rural landscape improvement and is of particular interest to those desiring information on the planting and arrangement of hardy perennials for beautifying the home grounds. (78 pages, 50 figures.)

Circ. Bul. 137.—PESTS OF APPLE AND PEAR IN MICHIGAN.—Pettit, R. H. and Hutson, Ray.—Description of the life history, distribution, and habits of the common pests of apple and pear and the relation of these facts to practical control measures. The insects discussed are selected upon the basis of inquiries concerning them. The bulletin is arranged for ready reference into sections dealing with attacks on foliage, foliage and fruit, fruit, and trunk, limbs, and bark. (63 pages, 59 figures.)

Sp. Bul. 214.—INSECT AND ALLIED PESTS OF PLANTS GROWN UNDER GLASS.—McDaniel, E. I.—A discussion of the principal greenhouse pests. Special stress is put on habits, life-history, type of injury, and control. There is a table of contents in the front for ready reference and a 17-page host index in the back. (117 pages, 71 figures.)

Tech. Bul. 112.—RESIDUAL EFFECTS OF FRUIT THINNING WITH THE LOMBARD PLUM.—Waring, J. H.—The general effect of fruit thinning with the Lombard plum was to increase the size of the fruit, but in the case of heavy thinning not enough to compensate for the reduction in number of fruits. The thinned trees made considerably more vegetative growth than those unthinned both the year the thinning was done and the following year; some growth effects continued even to the fourth following year. It is strongly indicated that the development of trees to large size is more rapid with consequent increased capability to carry large crops to maturity when fruit thinning is regularly practiced. It is also indicated that thinning will provide the most essential basis for regular, as opposed to alternate, cropping. (36 pages, 15 figures, 16 tables.)

Tech. Bul. 113.—THE STONE CELLS OF PEAR FRUITS, ESPECIALLY THE KIEFFER PEAR.—Crist, J. W. and Batjer, L. P.—Stone cell formation is a process of regular lignification, consisting in a heavy layer-thickening of the walls of ordinary parenchymatous cells in the fruit flesh. Once begun, it proceeds very rapidly, reaching a maximum in the Bartlett within three to four weeks, the Kieffer within four to five weeks. Having reached these maxima, a decline sets in, and continues uniformly until the fruit is ripe, the final content of stone cells being different with respect to the variety of pear concerned.

In an effort to significantly alter the stone cell content of the Kieffer

pear, the influence of the following factors was determined: nature of graft stock; age of tree; vigor of tree; size of fruit; punctures in epidermis of fruit; sealing up the floral end of the fruit; ringing of branches; defoliation of branches; branches defoliated, ringed and fruits sealed; fruits covered with black cloth bags; cultural practices, including fertilizer applications and irrigation; seasonal variations of climate; geographical location; date of picking, storage after picking; and ripening out of storage. The results were negative, except in two instances, namely, when the fruits were punctured and when they were allowed to develop within black cloth bags. Each of these two treatments increased the quantity of stone cells.

Whatever the actual process of cell lignification may be, enzymes must have important roles in it. Peroxidase activity is greatest in the Kieffer fruit, least in the Bartlett, and intermediate in Clapp Favorite. This conforms respectively with the grittiness of these varieties. However, the pear and the apple cannot be distinguished on the basis of peroxidase activity.

The stone cell phenomena of the pear fruit appear to be a matter of generic and varietal heredity. Improvement of the Kieffer pear fruit to any important extent would seem to depend solely on the manipulation of genetic factors. (55 pages, 21 figures, 18 tables.)

Tech. Bul. 114.—FERTILIZERS AND SOILS IN RELATION TO CONCORD GRAPES IN SOUTHWESTERN MICHIGAN.—Partridge, N. L. and Veatch, J. O.—Growth and production studies were carried out on an area where the soils were representative of a considerable proportion of the sandier vineyards of southwestern Michigan. Surface soil variations were due to slight differences in texture and to variations in the percentage of organic matter and to the thickness of the humus layer. The subsoil variations were found mainly in the quantity of clay mixed with the sand. In places, there is a compact layer at a depth of 10 to 30 inches but it is never tight enough to prevent the penetration of roots or to hold excessive amounts of water in any portion of the vineyard. Variations in the subsoil were not great enough to have a measurable influence on the growth or production of the vines. The thicker the humus layer of the surface soil the greater the vine growth and fruit production.

There was no great difference in the response of the vines to equivalent applications of ammonium sulphate or nitrate of soda, either causing greater growth and increased production. An additional, but smaller, increase in growth and productivity was observed when either superphosphate or muriate of potash was added to the nitrogen application. There was little further benefit when both superphosphate and potash were added to nitrogen than when either was used alone with nitrogen. Most of the benefit secured from the application of fertilizers was associated with the greater growth resulting from the treatment rather than from any direct response of fruiting to fertilization. The application of fertilizers in the spring of 1923 caused small increases in production that year but the major benefit that season was found in the more vigorous vine growth. Nitrogen applications were as effective in increasing production in 1924, the second year of the experiment, as they were in the following years, excepting

1925, a year of small production. The additional application of phosphorus or potash produced nearly as large an increase in the crop of 1924 as in the later years, although the results for 1928 and 1929 show a tendency toward slightly increased production. (42 pages, 18 tables, 7 figures, 1 colored plate.)

Tech. Bul. 116.—THE FRUITING HABIT OF THE PEACH AS INFLUENCED BY PRUNING PRACTICES.—Marshall, R. E.—Differential pruning treatments with Gold Drop peach trees gave a considerable range of growth responses which in turn offered an excellent opportunity to make a detailed study of the fruiting habit of the peach. Growth response data from the several pruning treatments, including data relative to the amounts of primary and secondary shoot growth and the points of origin and lengths of secondaries arising from the various points of origin, are presented. The greater portion of the publication deals with the relation of shoot length to bud yield, the regional distribution of various nodal bud arrangements on primary and secondary shoots of different growth classes, and allied questions. Another section is devoted to a study of the relation of pruning practices, shoot length, nodal bud arrangement and kind of wood to winter mortality of fruit and leaf buds. (58 pages, 26 figures, 19 tables.)

Tech. Bul. 117.—EXPERIMENTS WITH THE TUBER INDEX METHOD OF CONTROLLING VIRUS DISEASES OF POTATOES.—Kotila, J. L.—Although hill selection of potatoes has resulted in increased yields of high grade seed and table stock, virus diseases are not completely eliminated thereby. As a result, the virus diseases increase slowly until the stock is unfit for seed purposes. To overcome this imperfection in potato selection, the "tuber index" method of testing planting stock was tried out on a large scale. In this method individual tubers are grown in the greenhouse and apparently disease free single tuber strains or clons are selected. Disease-free clons of the varieties Bliss Triumph, Irish Cobbler, Russet Rural, Green Mountain, Spaulding Rose and Early Ohio were developed in this way. It was found practicable to increase the single tuber strains and distribute them to selected growers. In every case the clonal stock gave general satisfaction, over 9,000 bushels of stock from such seed being certified by the Michigan Crop Improvement Association in 1929. (26 pages, 5 tables, 11 figures.)

JOURNAL ARTICLE ABSTRACTS

DIFFERENTIATION OF THE SPECIES OF THE GENUS BRUCELLA.—Huddleson, I. F.—Jour. Pub. Health. 21 (5): 1931. (Jour. Article No. 48 (n. s.) from the Michigan Agr. Exp. Station.)—A total of 656 strains of Brucella from Europe and North America have been studied in their growth behavior toward aniline dyes in a suitable medium. It has been found that these strains divide themselves into three groups or species, according to the growth inhibiting action of thionin in a final dilution of 1-30,000, and pyronin in a final dilution of 1-200,000 in beef liver infusion agar at a pH of 6.6. Of the total number, 133 have been classified as *Br. melitensis* (Bruce), 352 as *Br. abortus*

(Bang), and 172 as *Br. suis* (Traum). *Br. melitensis* grows on both the thionin and pyronin dye medium, while *Br. abortus* grows only on the one containing pyronin and *Br. suis* only on the one containing thionin. The strains of *Br. abortus* may be divided into 2 classes: those which completely reduce basic fuchsin (final dilution 1-25,000 in beef liver infusion agar,) and those which slightly reduce this dye. It appears, on the basis of isolated cultures, that the latter class is the one that is pathogenic for man. When more than one species of Brucella occurs in blood culture or other infective material, the dye method and H_2S metabolism determination will separate and identify each of the species. The growth inhibiting action of these dyes, especially pyronin, offers possibilities in the therapeusis of undulant fever in man and Brucella infections in animals.

A CRITICAL STUDY OF THE BRUCELLA AGGLUTINATION REACTION AND ABORTION RATE IN A HERD OF CATTLE UNDER NATURAL CONDITIONS.—Huddleson, I. F. and Smith, L. H.—Jour. Am. Vet. Med. Assoc. 79. N. S. 32 (1): 63-78. 1931. (Journal Article No. 49 (n. s.) from the Michigan Agr. Exp. Sta.)—The trend of the agglutination titer for *Brucella abortus* (Bang) is presented on a herd of 541 dairy cattle, 143 of which have never shown a reaction in the slightest degree. The data have been collected for a period of eight years. All animals reported on have been in the herd one or more years and have been tested two or more times.

The number and per cent of animals reverting back to reactions which would be considered negative are set forth in Table 1.

Table No. 1.—Summary of reacting animals reverting to incomplete and negative reaction.

	Agglutination Titer			
	+1-25	+1-50	+1-100	+1-200 and 500
Total number	26	32	24	165
Number reverting to partial or trace in 1-25	8	10	3	9
Per cent	30 7	31.0	12.0	5.4
Number reverting to negative	0	0	2	2
Per cent	0	0	8 0	1.2

The abortion rate in animals remaining negative and at their maximum agglutination titers is set forth in Table 2.

Table No. 2.—Number of abortions occuring in animals during the period of observation and summarized under their maximum agglutination titers.

	Agglutination Titers					
	Negative	Trace and incomplete 1·25	Complete 1:25	Complete 1.50	Complete 1:100	Complete 1:200 1.500
Total number of animals........ ..	143	151	26	32	24	165
Number aborting............	22	39	6	12	9	88
Per cent.	15 3	25 8	23	37 5	37 5	53 3

It is evident from the data collected in this herd that a considerable percentage of animals showing only low reactions revert to a negative reaction. The percentage of high reactions that later revert to a negative reaction is very small.

THE VITAMIN A CONTENT OF ASPARAGUS, GROWN UNDER LIGHT OF VARIOUS QUALITIES.—Crist, J. W. and Dye, M.—Jour. Biol. Chem. 91 (1) : 127-134. 1931. (Journal Article No. 50 (n. s.) from the Mich. Agr. Exp. Sta.)—The effect of light on growing plants is conditioned by its quality, or the proportions of the various wave lengths present in a beam of it, as well as by its quantity or intensity. Asparagus tips have been produced under light filters which gave spectra of types which resulted in the tips ranging from a fully green color to no greenness whatever. When albino rats were fed daily on these tips as the sole source of Vitamin A, they grew more rapidly as the tips used were greener in color. This points again to the probability of there being a positive relationship of some order between the chlorophyll content of plant tissue and its Vitamin A potency, and furthermore, justifies the consumer of fresh or canned vegetables in exercising a preference for those forms that are fully green.

NATURAL BRUCELLA INFECTION IN SWINE.—Johnson, H. W. and Huddleson, I. F.—Jour. Am. Med. Assoc. 78, N. S. 31 (6) : 849-862. 1931. (Journal Article No. 53 (n. s) from the Mich. Agr. Exp. Sta.)—The findings set forth in this paper may be summarized as follows:

Brucella infection in swine appears to be due to one species of Brucella, namely, Br. suis (Traum).

The rapid agglutination test is an accurate method of following the course of Brucella infection in swine.

Brucella infection in swine appears to be a self-limiting disease, the majority of animals recovering at most within five months from the time agglutinins first appear in their blood.

Infected sows or gilts do not conceive as readily as those that are not infected.

The infection appears to be confined chiefly to the lymphatic tissues.

The capacity of Br. suis to invade the gravid uterus of sows or gilts does not appear to be marked.

The field survey indicates that the disease is very prevalent in hogs in the State of Michigan.

THE EFFECT OF FERTILIZERS AND SOIL TYPES ON YIELD AND QUALITY OF FIBER.—Robinson, B. B. and Cook, R. L.—Jour. Am. Soc. Agron. 23(7):497-510. 1931. (Journal Article No. 56 (n. s.) from the Mich. Agr. Exp. Sta.)—A study was made to determine the effect of soil type and fertilizer on the total yields of straw, fiber and seed, the percentage of fiber in the straw and the quality of fiber of fiber flax. Field tests were made on four different soil types, each experiment covering a period varying from one to four years.

It was found that the heavier types of soil out-yielded the lighter soil consistently. Brookston, a heavy soil, gave much greater straw and fiber yields for three years than did Hillsdale, a medium heavy soil. Application of fertilizer to the lighter soils did not cause them to give yields equal to the untreated heavier soils.

Nitrogen when added to combinations of phosphorus and potash fertilizers gave no increased fiber yields and only slightly increased seed yields.

Phosphorus alone did not increase the yield of fiber and seed. When phosphorus was applied with potash increased yields were obtained. It was noted that additions of phosphorus often caused an increased length of straw.

Potash applications were correlated with increased yields of fiber and seed when applied with phosphorus.

Calcium, which had been applied to the soil one year before the experiments were started, increased the yields only slightly and tended to lower the percentage of fiber in the straw. This element also in most cases lowered the fiber strength and the hackling percentage, thus indicating a poorer quality of fiber.

Magnesium when applied with calcium counteracted the bad effect of the calcium in the fiber strength.

The Bulletins of this Station are sent free to such individuals as may request them. Address all applications to the Director, Agricultural Experiment Station, East Lansing, Michigan.

LIST OF AVAILABLE BULLETINS

Regular Bulletins—

262 Suggestions on Planting Orchards.
264 Second Report of Grade Dairy Herd.
267 Michigan Weeds (only to Michigan libraries and teachers. Others 25c).
277 Studies in the Cost of Market Milk Production.
281 Beautifying Farm Home Grounds.
284 Some Information and Suggestions Concerning the Use of Phosphorus.
286 Studies and Cost of Milk Production—No. 2.

Special Bulletins—

71 Studies in the Range and Variation of the Per Cent of Butter Fat in the Milk of Individual Cows.
83 Key to Orthoptera of Michigan.
91 Lime for Michigan Soils.
94 The Financial History of a Twelve-Year-Old Peach Orchard.
98 Vinegar.
100 Soy Beans.
101 Oats in Michigan.
106 Sugar Beet Growing in Michigan.
107 Diseases of Bees in Michigan.
110 Special Report of the Upper Peninsula Experiment Station.
111 Studies in City Milk Distribution.
120 The Microscopic Identification and Determination of the Specific Ingredients in Stock Feeds.
123 Second Growth Hardwood Forests.
124 The Colorimetric Hydrogen-ion Determination as a Means of Locating Faulty Methods at City Milk Plants.

126 An Analysis of the Peach Variety Question in Michigan.
127 Nitrogen-Carrying Fertilizer and the Bearing Habits of Mature Apple Trees.
128 Sandy Soils of Southern Peninsula of Michigan.
130 The Clovers and Clover Seed Production in Michigan.
135 Seasonal Management for Commercial Apiaries.
138 Rural Highways.
139 Tourist Camps.
141 Profitable Pruning of the Concord Grape.
142 Grafting in the Apple Orchard.
143 Winter Pruning the Black Raspberry.
144 Spraying Dewberries for Anthracnose.
147 Cherry Leaf Spot.
149 Eighty Winters in Michigan Orchards.
150 Emergency Hay and Pasture Crops.
151 Buckwheat in Michigan.
152 Sweet Clover.
153 Peppermint Growing in Michigan.
154 Hardy Shrubs.
155 The Mint Flea Beetle.
156 Investigation With Strains of Beans.
157 Celery Culture in Michigan.
158 A Suggested Bacteriological Standard for Ice Cream.
159 Production of Ice Cream With a Low Bacterial Count.
160 Why a Cull Apple Is a Cull.
161 Varieties and Locations as Factors in Apple Production.
162 Pruning the Red Raspberry.
163 Forest Planting in Michigan.
†164 Diagnosing Orchard Ills.
165 Management Methods in the Raspberry Plantation.
166 Studies in Orchard Management with Special Reference to Cherry Production.
167 Chicory Growing in Michigan.

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†This is a popular bulletin on the identification of the more common disorders of tree fruits in Michigan. It should be found generally useful as a work of reference for practically everyone interested in the raising of fruit.

Because of the unusual expense of the color plates it will not be distributed to the entire mailing list but will be sent to those who specifically request it, upon the receipt of ten cents (coin or stamps).

169 Profit and Loss in Pruning Mature Apple Trees.
170 The Detroit Milk Market.
171 Farmers' Co-operative Buying and Selling Organizations in Michigan.
172 Farm Real Estate Assessment Practices in Michigan.
173 The Principal Bulb Pests in Michigan.
174 Spraying Calendar.
175 The Rural Cemetery.
176 The Uses of Cut Flowers.
177 The Significance of Soil Variations in Raspberry Culture.
179 Forest Insurance and Its Application in Michigan.
180 The Soils of Michigan, Grayling Sand.
181 A Study of Town-Country Relationships.
182 Strawberry Growing in Michigan.
183 Common Pests of Field and Garden.
184 Size of Peaches and Size of Crop.
185 Roadside Marketing in Michigan.
186 Chrysanthemum Breeding.
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188 Pollination of Orchard Fruits in Michigan.
189 The Marketing of Michigan Milk.
190 Oak Forests of Northern Michigan.
191 Barley for Michigan Farms.
192 Causes and Effects of Soil Heaving.
193 Cantaloupe Production in Michigan.
194 The Use of Peat in the Greenhouse.
195 Maintaining the Productivity of Cherry Trees.
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202 The Propagation of the Highbush Blueberry.
203 Spraying Materials and the Control of Apple Scab.
204 Investigations of Corn Borer Control at Monroe, Mich.
205 Soil Fertilization for Sugar Beets.
206 Types of Farming in Michigan.

207 Public Health and Educational Services in Michigan.
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209 Consumer Demand for Apples in Michigan.
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71 Fertilizer Suggestions for Barry County Soils.
72 Fertilizer Suggestions for Berrien County Soils.
73 Fertilizer Suggestions for Cass County Soils.
74 Fertilizer Suggestions for Hillsdale County Soils.
75 Fertilizer Suggestions for Ingham County Soils.

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76 Fertilizer Suggestions for Isabella County Soils.
77 Fertilizer Suggestions for Kalamazoo County Soils.
78 Fertilizer Suggestions for Livingston County Soils.
79 Fertilizer Suggestions for Macomb County Soils.
80 Fertilizer Suggestions for Muskegon County Soils.
81 Fertilizer Suggestions for Ottawa County Soils.
82 Fertilizer Suggestions for St. Joseph County Soils.
83 Fertilizer Suggestions for Van Buren County Soils.
85 Honey Vinegar.
87 Apple Maggot.
88 Fertilizer Suggestions for Calhoun County.
90 Cucumber Culture.
91 Arbor Day Programs for Rural Schools.
93 "Sting" on Apples.
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95 Feeding Minerals to Dairy Cattle.
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117 Distribution of Acid Soils, Muskegon County.

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7 Corn Club Work.
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18 Poultry Club Project.
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32 The Transmission of Bacterium Abortus (Bang) to the New Born Calves Through the Ingestion of Milk.

33 A Study of the Presence of Bacterium Abortus (Bang) in Milk.

34 A Study of the Factors Which Govern Mating in the Honey Bee.

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THE

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AGRICULTURAL EXPERIMENT STATION
MICHIGAN STATE COLLEGE
Of Agriculture and Applied Science

East Lansing, Michigan

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CONTENTS

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CONTRIBUTIONS BY ALL SECTIONS OF THE
AGRICULTURAL EXPERIMENT STATION

MICHIGAN AGRICULTURAL EXPERIMENT STATION QUARTERLY BULLETIN
Vol. XIV, No. 3, February, 1932

MICHIGAN CONTEST HAS SUCCESSFUL YEAR

Records of Ninth Contest Prove High Producing Hens Can Make Profit Even When Egg Prices Are Low

E. S. WEISNER, SECTION OF POULTRY HUSBANDRY

The ninth annual Michigan Egg Laying Contest upon its completion September 22, 1931, provides a fund of information of interest and value to the poultrymen. The contest consisted of 100 entries of 13 birds each, comprising five of the most popular breeds and varieties. These birds were representatives of 85 flocks and as many breeders from this and other States.

All the birds were trapnested and individual production records obtained. In addition, complete records were kept of the number of eggs sold, prices and total receipts, feeds and materials consumed or used, and the number and causes of deaths. These data are summarized in Tables 1 to 3.

Table 1.—Number of birds, breeds, average production and deaths for the year.

Breed	Number of birds	Average production*	Number of deaths	Percentage mortality
Barred Rocks	221	155 9	67	30 6
White Rocks	52	142 9	11	21 1
White Wyandotte	13	195 3	3	23 1
S. C. R. I. Reds	78	186 8	12	15 3
Leghorns	936	206 0	199	21 2
All Breeds	1,300	193 7	292	22 4

*Average production based on ten high individuals in each entry; mortality figured from all birds entered.

There were 292 deaths during the year. In some cases, diagnosis showed two or more diseases or contributing factors responsible for death. The diseases and maladies most often encountered were Leucosis, sarcamatosis, fowl pox, roup, and yolks in the abdomen. The number of birds showing yolks in the abdomen is becoming greater each year. This condition may be explained in part as due to birds being bred and fed for heavy egg production and the organs of reproduction are subjected to a heavy strain.

Several interesting points are brought out in Table 2 which gives production percentage, total dozens of eggs marketed, receipts, average selling price per dozen, and the number of deaths by months. All production percentages are based on 1,000 birds, as the 10 high individual records are

Table 2.—Eggs sold and value per month with average price per dozen.

Month	Percentage production	Total doz.	Value	Average selling price per doz.	Number of deaths by months
October	33.5	800	$232.80	29.1 cents	13
November	35.1	839	307.91	36 7 "	18
December	39.2	996	404.70	40 6 "	27
January	55.8	1,514	559.49	37.0 "	15
February	65.3	1,522	352.89	23.1 "	22
March	68.8	1,771	373.28	21 1 "	34
April	67.2	1,827	380.43	20 3 "	24
May	66.1	1,680	304.60	17.1 "	33
June	58.5	1,611	369.20	16.7 "	26
July	58.5	1,522	275.31	18.0 "	34
August	51.9	1,248	256.60	20.5 "	28
September	44.6	789	182.66	23 1 "	18

Average 25.27 cents.

Table 3.—Feeds and materials used, amounts of each, average price per unit and total costs.

Material	Amount	Price	Total
Scratch Grain:			
Corn	11.72 Tons	$32.25 Ton	$377.97
Wheat	11.72 Tons	.62 Bu.	242.17
Mash	26.55 Tons	44.50 Ton	1,181.47
Straw	12 00 Tons	6 00 Ton	72.00
Semi Solid Buttermilk	4,562.5 Lbs.	3.35 Cwt.	152 84
Oyster Shell	3,381 0 Lbs.	.90 Cwt.	30.43
Grit	2,198 5 Lbs.	.90 Cwt.	19 79
Charcoal	545.0 Lbs.	2.27 Cwt.	12 37
Cod Liver Oil	503 5 Lbs.	.70 Gal.	44.73
Cartons	10,000	12.00 M	120 00
Egg Cases	25	.20 Each	5 00
Total	....	....	$2,258.77

Cost of Feeds and Materials per Hen	$1 93
Return above Costs	1 96
Cost per Doz. Eggs	.14

taken in each entry as representative of the unit. Production reached its peak in March and April and was lowest in October and November. Prices were highest in December and lowest in May and June. There was, therefore, a lag of about two months between the time of lowest production and highest prices in the fall and highest production and lowest prices in the spring. The fluctuation from month to month in the selling price per dozen shows that there is a yearly cycle in prices, reaching the peak during December and gradually subsiding until July where again the trend is upward.

One of the most significant things brought out by these records becomes evident when the figures in Table 3, showing amounts and costs of feed consumed, are combined with those in Table 2 showing egg production and prices. Though the feed and material cost per hen was $1.93, this amounted to only $0.14 per dozen eggs. The average selling price was a trifle over $0.25 per dozen, leaving a return of $0.11 per dozen or $1.96 per hen to cover labor, housing, and other overhead and miscellaneous charges. It is obvious that with high producing birds of this type a substantial profit can

be realized even though the price range is low. It is also obvious that as average egg production falls below these figures, the margin of profit dwindles and eventually disappears because feed, labor, and other costs are not correspondingly lowered.

MAKE SURVEY OF COSTS OF RAISING PULLETS

Records Kept by 37 Michigan Farmers Show Wide Variations in Expense

K. T. WRIGHT, SECTION OF FARM MANAGEMENT

What it costs to produce a pullet is a problem every poultryman has to consider. The Farm Management Department of this institution, believing that it should help to solve the problem, started a special study in the spring of 1931. This enterprise study on baby chicks was to provide information on the following points: (1) The average and the extreme range in the amount of the charges and credits per pullet raised on a representative number of farms, and (2) the relation of management practices to net cost per pullet at 24 weeks of age, and to the profit or loss in the baby chick enterprise.

The account on the baby chicks was kept in the Baby Chick Record books prepared by this department. The 37 farmers that completed their account in these books kept a record of the cost of the chicks, of the amount and value of feed fed to them, of the amount of time spent caring for the chicks, and of all other expenses and any income obtained from them before they were 24 weeks old. Each book has been summarized showing the cooperator exactly how much it cost him to produce his pullets The results of the study have been put in mimeographed form and each cooperating farmer received one of these reports. Every farm is shown in this report. Each farm is given a key number and every farmer knows the number given to his farm. In addition to showing each farm, this report also contains the average results for all cooperators, the average of the 10 low-cost and the 10 high-cost producers, special Tables on certain practices, and the costs up to 12 weeks on some of the farms.

In this group of 37 farms, located in the Detroit, Grand Rapids, and Holland areas, there were 23 flocks of White Leghorns, 11 flocks of Barred Rocks, and one flock each of Brown Leghorns, Black Minorcas, and Rhode Island Reds. There were extreme variations on these farms in the number of chicks raised, the net cost of the pullets, practices followed, and many other features of the baby chick enterprise. The number of chicks at the start ranged from 152 to 2,274. Mortality varied from 2 to 39 per cent at the end of the 24 week's period. Net cost of the pullets at 24 weeks of age ranged from 9c to $1.64 a pullet.

Table 1.—Total charges and credits on the baby chick enterprise—1931.

Items	Average 10 low-cost farms	Average 10 high-cost farms	Average all 37 farms
Baby chick cost	$63.51	$104 15	$70 45
Feed cost	116 11	194 74	133 65
Man labor charge	38 16	81.82	51 74
Equipment and buildings charge	20 05	34 16	22 52
Other costs	30 49	64 99	38 91
Total cost	$268 32	$479 86	$317 23
Value of poultry on hand	294.49	311.22	259 49
Poultry sold and used	118 11	137 14	112 58
Other credits	16 12	11 22	13 77
Total credits	$428 72	$459 48	$385 84
PROFIT OR LOSS	160 40	—20 28	68 61
Return per hour man labor	1 30	02	.58

Table 2.—Charges and credits for each pullet raised up to 24 weeks.

Items	Average 10 low-cost farms	Average 10 high-cost farms	Average all 37 farms
Baby chick cost	$ 22	$ 39	$ 29
Feed cost	40	72	.55
Man labor charge	.13	.30	21
Equipment and buildings charge	07	13	09
Other costs	11	24	16
Total cost	$ 93	$1 78	$1 30
Credits other than pullets	56	69	61
NET COST PER PULLET	37	1 09	.69

Table 3.—Notes, factors of efficiency and practices.

Items	Average 10 low-cost farms	Average 10 high-cost farms	Average all 37 farms
Date hatched	April 20	April 18	April 15
Number chicks at the start	710	785	638
Number males raised	307	381	294
Number pullets at 24 weeks	289	269	245
Number pullets per 100 chicks	41	34	38
Per cent mortality	16 6	17.4	15 7
Broiler age when sold (weeks)	14	12	13
Pullet age first egg laid	19	22	20
Pullet weight at 24 weeks	3 4	3 6	3.5
Broiler weight when sold	2 1	2 0	2.0
Pounds of males per pullet	2 5	3 0	2 6
Sale price of broilers (lb.)	20	20	20
Pounds mash per lb. poultry	2 4	3 9	3.1
Pounds scratch per lb. poultry	1 8	2 2	2.0
Chicks raised on new ground	100%	60%	68%
Was milk fed in some form	90%	60%	76%
Was cod liver oil fed	30%	60%	41%

These 37 farmers started with 23,600 chicks or 638 per farm, and the chicks cost an average of 11 cents each. At the end of the 24 weeks' period 16 chicks had been lost out of each 100 at the start, for all the farms; and, from the 638 chicks, there were 245 pullets kept for layers. The net

cost of the pullets at 24 weeks of age averaged 69 cents each, after deducting 61 cents credit for broilers sold, used and any income other than the pullets themselves. Of the total cost, feed constituted 42 per cent, the cost of the chicks 22 per cent, labor 16 per cent, use of equipment and brooder house 7 per cent, and other costs 13 per cent. The bulk of the baby chicks were purchased around April 15. The broilers were generally sold when about 13 weeks old. According to these records, the pullets were usually about 20 weeks old when the first egg was laid, and the average weight of the pullets was 3.5 pounds when 24 weeks old.

The records of the 10 poultrymen having the lowest net cost per pullet when 24 weeks old and of the 10 having the highest cost were placed in two groups and averaged in order to study the reasons for the differences.

Fig. 1.—Chicks raised on clean ground made the cheapest and healthiest pullets.

The average net cost per pullet for the first 10 was 37 cents and for the high cost 10 farms $1.09. The two groups had about the same number of chicks at the start, but those having the lower costs paid 9 cents per chick and the other group paid an average of over 13 cents a chick. This would appear to indicate that the high-cost group bought better chicks, but the mortality at 24 weeks averaged 16.6 per cent and 17.4 per cent respectively. Out of every 100 chicks at the start, the low-cost group saved 41 pullets and the high-cost group only 34 pullets. All of the men in the first group raised their chicks on clean ground, while only six of the 10 in the high-cost group followed that practice. Nine out of low-cost 10 fed milk in some form and only six of the other 10. The men having the lowest pullet cost fed 4.2 pounds of mash and scratch to produce a pound of poultry while the high-cost 10 averaged 6.1 pounds of feed. There was practically the same per-percentage of heavy and light breeds in the two groups, so the preceding differences must have been due to better feeding and management practices.

Further study was made on the variations in pullet costs by sorting the farms on the basis of different factors. A comparison was made on the heavy and light breeds. The 12 men having heavy breeds had an average pullet cost of 58 cents at 24 weeks and the pullets weighed 4.4 pounds, while the 25 having light breeds had a cost of 72 cents for 3.4 pound pullets. The main reason for the difference in the net cost per pullet lies in the fact that the heavy breed broilers weighed 2.7 pounds when sold and brought nearly 24 cents a pound, while the light breeds weighed 1.8 pounds and sold for 18 cents a pound. In other words, the light breed broilers sold for 32 cents each on the average and the heavy for 64 cents. There was a difference, however, in the age at which the birds were sold, averaging nearly 12 weeks for the light breeds and about 15 weeks for the heavy. The amount of feed consumed for each pound of poultry produced was about the same for both heavy and light breeds.

Table 4.—A comparison of the heavy and light breeds.

Items	Heavy	Light
Number farms	12	25
Net cost per pullet (cents)	58.0	72.2
Weight of pullet at 24 weeks (pounds)	4.4	3.4
Age broilers when sold (Av. in weeks)	14.8	11.6
Weight broilers when sold (pounds)	2.7	1.8
Sale price per pound of broilers (cents)	23.8	18.0
Amount received per broiler (cents)	64.3	32.4
Pounds mash per pound poultry	2.4	2.9
Pounds scratch per pound poultry	2.2	2.0
Pounds broiler per pullet	4.3	2.2

The farms were then sorted on the basis of the feed cost per pullet. This cost at 24 weeks of age ranged from 29 cents to 92 cents on these 37 farms. One-third of the men got their pullets up to 24 weeks with an average feed cost of 33 cents and the pullets weighed 3.3 pounds. These men fed 4.4 pounds of feed for each pound of poultry. The 10 farms on which the feed cost was highest, had an average cost of 75 cents per pullet for feed, and the pullets weighed 3.9 pounds each at 24 weeks of age. Over six pounds of feed was fed per pound of poultry, most of the increase being in mash consumption.

Table 5.—Relation of feed cost to net cost and practices.

Items	Feed Cost per Pullet		
	Under 40c	40 to 60c	Over 60c
Number farms	12	14	10
Feed cost per pullet (cents)	33	49	75
Net cost per pullet (cents)	46	65	1.01
Pounds mash per pound poultry	2.4	2.9	3.9
Pounds scratch per pound poultry	2.0	2.0	2.2
Number pullets per 100 chicks	39	38	37
Weight of pullets at 24 weeks (lbs.)	3.3	3.6	3.8
Pounds broilers per pullet	2.2	2.5	3.2
Weight of broilers when sold (lbs.)	2.1	2.1	2.5
Age of broilers when sold (average in weeks)	12.5	12.3	13.1

Thinking that the age at which the broilers were marketed might be an important factor, the farms were sorted on that basis. About one-third of the cooperators sold their broilers at 10 weeks of age or less, another third from 11 through 13 weeks and the other third at 14 weeks and over. The average broiler age when sold was 9.7 weeks, 12.3, and 16.7 weeks respectively. The net cost of the pullets averaged 69 cents for the first group, 58 cents for the middle group, and 71 cents for those keeping their broilers the longest. Average sale price of the broilers per pound was 17 cents, 20 cents and, 21 cents for the three groups. The group selling their broilers at the age of 11 to 13 weeks were the only group "breaking even," figuring the broilers at sale value and estimating the value of the pullets on a meat basis at 12 weeks of age. Those selling the broilers younger than the above group lacked 4 cents per chick of meeting costs on the above basis, and those selling at 14 weeks and over lacked 5 cents per chick.

Table 6.—Relation of age of broilers when sold to net costs of pullets.

Items	Broiler age when sold		
	10 weeks and less	11, 12 and 13 weeks	14 weeks and over
Number farms	11	10	11
Age of broilers when sold (weeks)	9 7	12 3	16 7
Net cost per pullet (cents)	69	58	71
Date chicks hatched (average)	April 15	April 12	April 18
Date broilers sold (average)	June 24	July 7	August 13
Average sale price—Heavy breeds (cents)	23 0	23 6	24 1
Average sale price—Light breeds (cents)	16 8	19 4	18 0
Average sale price—all breeds (cents)	17 0	20 1	21 0
Margin @ chick at 12 weeks at meat price, (cents)	- 4 3	0	- 5 0

In the production of pullets, the males are usually sold as broilers and considered a by-product of the enterprise. In some industries, the method of handling the by-product is the important factor in determining profits. An analysis of the costs of producing baby chicks up to 12 weeks of age was made on 23 of the farms keeping records. This is the age when the males are marketable and consequently the cost at this stage has been determined.

The Table on the cost of producing baby chicks up to 12 weeks of age shows that the production of broilers was not very profitable last year. The farms studied produced 12-week-old chicks at a cost of 35.2 cents. There was a loss of 1.6 cents per chick if all chicks were figured at meat prices. Of the total cost of producing chicks to 12 weeks of age, feed constituted 36.4 per cent, the cost of the chicks 32.3 per cent, labor 15.1 per cent, and other costs 16.2 per cent. These costs were with an average mortality of 11.3 per cent and an average hatching date of April 18th.

A comparison of the light and heavy breeds brings out some interesting differences. The cost of producing a pound of poultry at 12 weeks was 21 cents per pound for both. The chicks cost 9.8 cents for the light breeds and 10.5 cents for the heavy breeds. The mortality was less in the light breeds also, being 11.3 per cent as against 14.6 per cent for the heavy breeds. The total cost per chick in the light breeds was 33.3 cents and 43.3 cents in the heavy breeds. The estimated value of the chicks in the light breeds was 30 cents and 46.5 cents in the heavy breeds. This shows a

loss of 3.3 cents per chick in the light breeds and a profit of 3.2 cents in the heavy breeds at 12 weeks of age. The difference in the margin per chick raised was accounted for by the 4.7 cents per pound extra sale price and the .4 pound extra weight per chick for the heavy breeds.

Table 7.—Costs of growing baby chicks to 12 weeks age (Per chick at that age).

Items	White Leghorns	Barred Rocks	All Farms
Baby chick cost (cents)	11 2	12 3	11 4
Cost of mash	9 7	13 0	10 4
Cost of scratch	2 2	3 9	2 4
Labor charge	4 8	7 3	5 3
Other costs.	5 4	6 8	5 7
Total cost per chick (cents)	33 3	43 3	35 2
Number farms	17	6	23
Purchase price of chicks	9 8	10 5	10 0
Number chicks at start	617	460	576
Number broilers sold and used	281	217	264
Per cent mortality	10 5	14 6	11 3
Broiler age when sold (weeks)	11 3	13 8	11 8
Broiler weight when sold (pounds)	1 8	2 5	1 9
Broiler sale price per pound (cents)	18 6	23 3	19 7
Estimated weight of chicks	1 6	2 0	1 7
Estimated value per chick (cents)	30 0	46 5	33 6
Estimated margin per chick (cents)	- 3 3	3 2	—1 6

Summary

1. The average net cost per pullet at 24 weeks of age on 37 farms in 1931 was 69 cents.
2. The 10 most efficient farmers had a net cost of 37 cents per pullet.
3. The high-cost 10 farms averaged $1.09 net cost per pullet.
4. These 37 farms average 638 baby chicks at the start, which was usually around April 15th.
5. At 12 weeks the mortality was 11.3 per cent and at 24 weeks 15.7 per cent.
6. Average cost per chick at 12 weeks was 35.2 cents, which was 1.6 cents less than their estimated value at meat prices.
7. The broilers were usually sold around 13 weeks of age and weighed 2.2 pounds. The average sale price was 20 cents a pound.
8. At the age of 24 weeks, the average had 38 pullets out of every 100 chicks, while the 10 low-cost farms had 41 and the 10 high-cost 34.
9. Pullets of the light breeds averaged 3.4 pounds at 24 weeks of age on 25 farms, and those of the heavy breeds 4.4 pounds on 12 farms.
10. Of the total costs at 24 weeks, feed constituted 42.2 per cent, the cost of the chicks 22.2 per cent, labor 16.3 per cent, equipment and brooder house charge 7.0 per cent, and other costs 12.3 per cent.
11. Average feed consumption of mash and scratch was 5.1 pounds per pound of poultry produced. The 10 most efficient pullet producers used 4.2 pounds and the high-cost farms 6.1 pounds of feed for each pound of poultry, and the feed cost $1.61 and $1.81 per hundred respectively.

CORYNEUM BLIGHT INJURES MICHIGAN PEACHES

Disease Has Been Known Many Years But Has Caused Little Loss In Past

DONALD CATION, SECTION OF BOTANY

Coryneum Blight of Peaches in Michigan

Coryneum blight of peaches (*Coryneum beijerinckii*), usually thought to be of minor importance in Michigan, has caused considerable damage to trees and fruit in several localities in the past several years. As this disease is not controlled by following the usual spray schedule, it is necessary that growers in the affected districts become familiar with the symptoms of the disease and with methods of control. *Occurrence*—Coryneum blight was first recorded from France in 1843. It is rather prevalent throughout Europe on peaches, apricots, cherries, and almonds and also occurs in Algeria, Australia, and New Zealand. In the United States, the first occurrence of the disease was reported from Michigan in 1893 by Longyear. It was later found in New York, Indiana, Ohio, California, and Oregon. It has assumed its most serious proportions in this country in the peach districts of California and on stone fruits generally in the Pacific Northwest

In Michigan, Coryneum blight has not attracted sufficient attention in most years to demand special investigation. However, in 1924 considerable damage was reported from Mason county, enough to cause concern to the growers. Detailed investigations regarding control measures were begun by Dr. C. W. Bennett in 1925 but were of no value as the disease disappeared because of an unfavorable season.

Within the past few years, this disease has again become prevalent in certain counties in the State, disfiguring the fruit, killing young twigs, and defoliating and generally weakening the trees.

Symptoms—In the dormant season, a badly diseased tree presents a mass of small cankers and dead twigs throughout the fruit-bearing area, involving much of the present and the last seasons' fruiting wood. Abundant gumming from diseased buds and cankers is especially evident in wet weather. The lesions or diseased areas on the one-year wood are dark brown in color, are circular to oval in shape, and often are accompanied by a longitudinal splitting of the bark. One two-year wood, the cankers frequently extend half way round the twig and often include the remains of a dead, charred bud. An example of cankers surrounding buds is shown in Figure 1. Diseased buds on the fruiting wood may be killed outright or they may start growth in the spring and later die after the leaves are out and the fruit is set. In such cases, the young fruit dies and falls off.

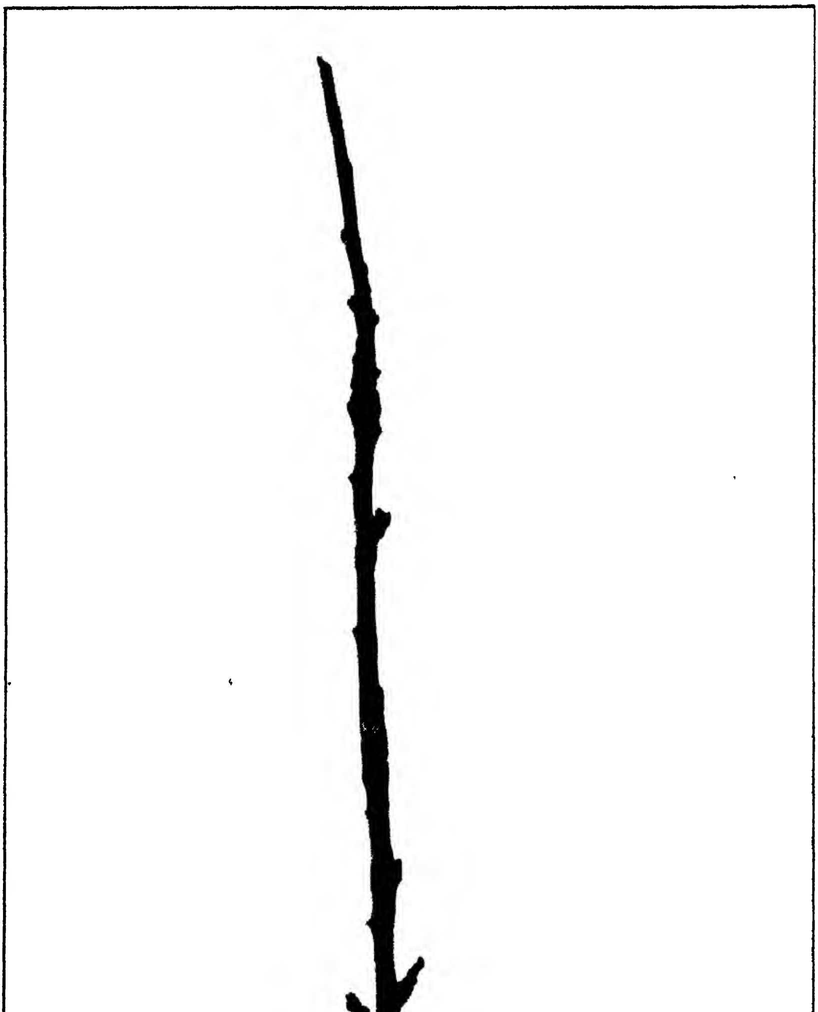

Fig. I.—Peach twig showing three cankers surrounding dead buds on two-year wood. The infected buds died and the cankers spread half way around the wood. A canker can also be seen at the junction of the one, and two year wood.

During the growing season, the new lesions are easily recognized by a characteristic red ring or margin which shows plainly in contrast to the green background of the leaves, young shoots, and fruits. On the fruits, the spots are at first small and are purplish red, resembling in appearance the effects of San-Jose scale. As the spots enlarge, a cream colored area develops in the center and the circular margin becomes a darker red to brown. Later, due to the death of the epidermal hairs, the lesions appear as rusty brown spots. Spots on the fruit are illustrated in Figure 2.

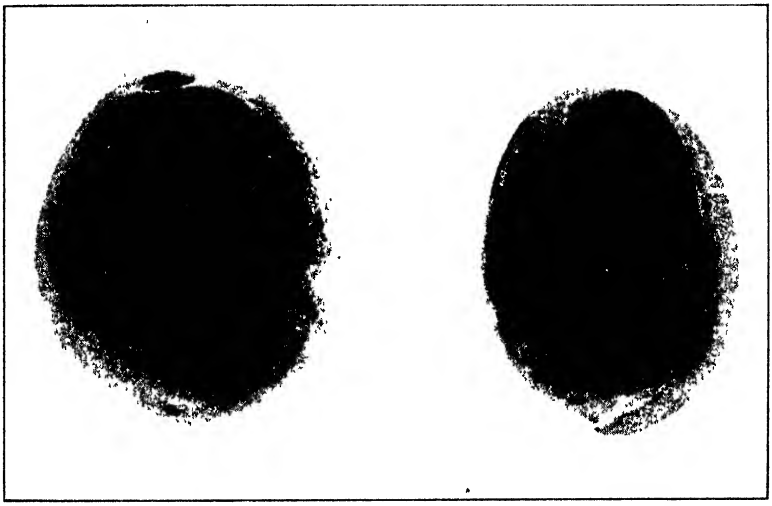

Fig. II.—Spots on fruit caused by "*Coryneum beijerinckii.*"

Fig. III.—An Early Crawford tree showing heavy defoliation due to Coryneum blight. Taken June 22, 1931.

Spots formed early on the leaves soon fall out and a typical shot-hole effect is produced. These holes are readily distinguished from other shot-holes by their smooth circular margin. Trees are often severely defoliated in the late spring and the additional energy used in forming new leaves inevitably weakens the tree. Figure 3 shows a lesion on young wood.

Status in Michigan in 1930-31

In 1930, Coryneum blight was present in scattered localities throughout the western peach belt but no serious damage was reported. It was also found in the eastern peach districts in Shiawassee, Oakland, and Washtenaw counties.

In 1931, specimens of the disease were received from Shiawassee, Oakland, Washtenaw, Hillsdale, and Leelanau counties. Though in most instances the damage has been slight, yet the disease has caused serious losses in at least one orchard in Shiawassee county and a number of growers in Washtenaw county have submitted specimens and inquired about the disease and its control.

Control by Spraying

In 1930, the foreman of a large orchard near Fenton reported 60, 40, 30, and 20 per cent defoliation on Early Crawford, Late Crawford, Prolific, and Elberta varieties respectively. As records for control of Coryneum blight were unavailable for Michigan conditions, the fall and spring Bordeaux applications, successfully used in California and Oregon, were advised and a suitable unsprayed check plot was suggested.

Accordingly, the orchard was divided into two blocks. The spring Bordeaux spray was finally omitted but Bordeaux mixture 8-8-50 was, however, applied only in the fall to a block of approximately 1,200 trees while another block of 2,000 trees received only the regular 1-10 lime-sulphur spring leaf-curl spray. Both blocks received the same summer sprays of dry-mix lime sulfur, 25 lbs. per 100 gallons, at pre-blossom, shuck fall, and at two weeks after shuck fall. A comparison of the controls obtained by these two spray materials applied at different times in the dormant season is shown in Table 1. It can be seen that a single fall Bordeaux spray applied to one orchard in 1930 gave a perfect commercial control while the spring application of 1-10 lime-sulphur had little effect upon the disease.

Table 1.—A comparison of bordeaux mixture and lime-sulfur sprays applied in the fall and spring respectively for control of Coryneum Blight in one orchard in 1931.

Block	Sprays used and time of application		Progress of disease		
			June 22 lesions on twigs and leaves	Sept. 1 fruits infected	Number lesions per fruit
	Oct., 1930	Apr., 1931	Amount	Per cent	Average
1	Bordeaux 8-8-50	None	Trace	1	1
2	None	Lime-sulfur 1-10	Severe	10	15

Varietal Susceptibility

A few outstanding differences in varietal susceptibility to Coryneum blight were noted in 1931. Whether or not these differences will remain constant in other seasons is not known. Early and late Crawford varieties showed the most infection while Prolific and Elberta, respectively, showed less. On June 22, 1931, typical Early Crawford trees were fully 50 per cent defoliated while adjacent Elberta trees showed approximately 1 per cent defoliation. At this time, practically all of the leaves on the new growth had dropped from the Crawford varieties and these were partially replaced by new leaves which were only half normal size. A photograph of a heavily defoliated Early Crawford tree at the same date is shown in Figure 3.

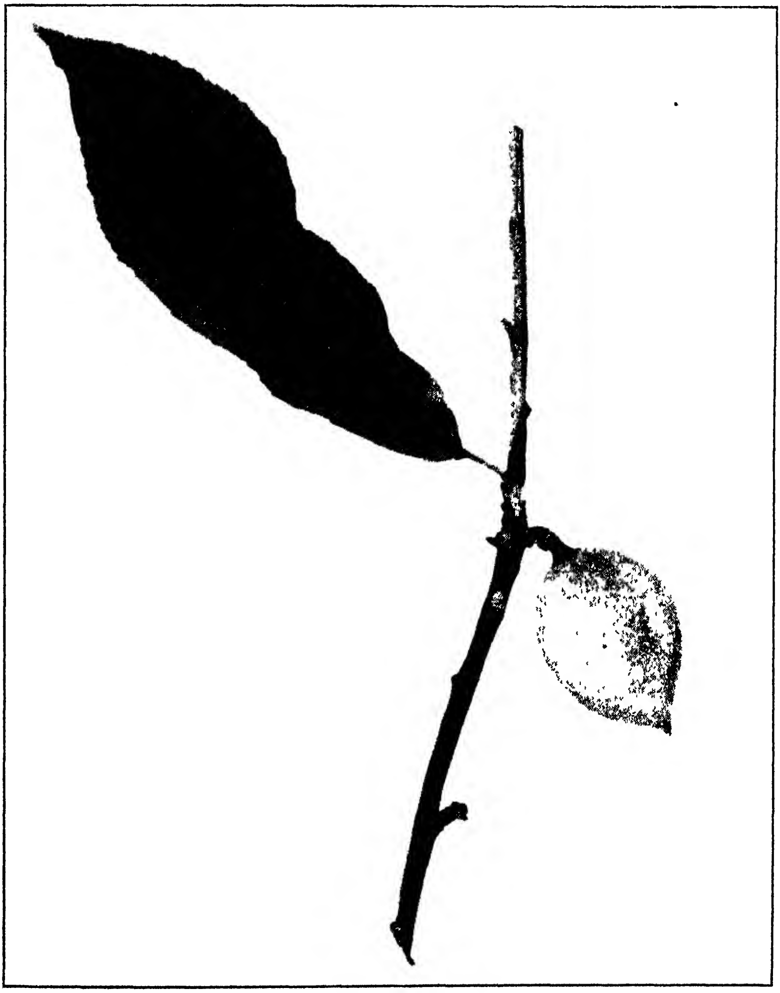

Fig. IV.—Coryneum blight lesion on new wood, showing the characteristic red margin and lighter colored center.

Suggestions for Control

1. A single application of Bordeaux mixture 8-8-50, applied in the fall just after foliage drop will usually control the disease. This application will also control peach leaf curl.
2. An additional spring application of Bordeaux at the same strength should be applied to dormant trees as a precautionary measure after an open, wet winter.
3. The fall spray is most important but if it was for any reason omitted, a spring application alone before the buds swell will help to reduce new infection.

MADE POTATO COSTS STUDY IN STATE IN 1930

Figures Show Table Stock Producers Lost Money on that Crop

K. T. WRIGHT, SECTION OF FARM MANAGEMENT

The cost of producing potatoes and the factors affecting the cost, were the subjects of a special farm management study started in 1930. From the standpoint of value, potatoes are one of Michigan's major crops, even though they usually occupy slightly over 3 per cent of the harvested crop acreage. It was the purpose of this special study to determine the costs of production; to study the relation of management practices to yields, costs, and profits; and to learn the relative profitableness of potato production in the various competing areas.

In this study on potatoes, three areas were represented; the east central section by Oakland and Tuscola counties; the Greenville area; and the certified seed area in the northwest part of the Lower Peninsula by Antrim, Charlevoix, and Otsego counties. Fifty-three farmers completed their records on the 1930 potato crop. These men kept account of the time spent on the crop; the value of the seed used; the cost of fertilizers, spray material, repairs on potato machinery; and any other expenses that should be charged to the potatoes. Of this group of 53 farmers, 33 were producing table stock potatoes and 20 were growers of certified seed.

The average costs and returns for each of the two groups and for all cooperators are presented in Table 1. In Table 1, all the figures are for one acre. The costs of production are shown in two sections, growing costs and harvesting costs. In determining the cost of production, man labor was charged at 25 cents an hour, horse labor at 15 cents, and tractor time at 90 cents an hour. The machinery cost was determined from an actual inventory and expense account, with potatoes being charged a certain share based upon usage. The charges for seed bought, seed treating material, fertilizer, spray material, and certification were taken from the farmers' record of the actual cost. If the farmer used his own seed it was figured

at market price. The value of the barnyard and green manure plowed under was estimated. General farm expense is the share of the farm overhead chargeable to potatoes.

Table 1.—Potato production costs for 1930 (acre basis). An itemized statement of the potato enterprise showing the average for all farms, and the average for the table stock and certified seed growers.

Items	Table stock 33 farms	Certified seed 20 farms	Average all 53 farms
GROWING COSTS (per acre):			
Man labor	$6 74	$11 83	$8 68
Horse labor	5 20	7 04	5 90
Tractor labor	1 28	1 86	1.50
Machinery	2 30	4 95	3 31
Seed	11 96	31.34	19 35
Barnyard manure	7 15	7 05	7 11
Green manure	1 50	1 08	1 34
Fertilizer	3 42	10 08	5 96
Spraying	1 15	4 70	2 50
Seed treating material	46	66	54
Certification		1 57	60
General farm expense	5 34	8 26	6 46
TOTAL	$46 50	$90 42	$63 25
HARVESTING COSTS:			
Man labor	6 63	8 80	7 45
Horse labor	1 79	2 19	1 95
Machinery	1 22	1 99	1 51
Miscellaneous		16	.06
TOTAL	$9 64	$13 14	$10 97
Taxes on land	1 13	1 44	1 25
Interest on land	2 88	2 44	2 71
TOTAL COST PER ACRE	$60 15	$107 44	$78 18
INCOME:			
Potatoes	59 27	125 46	84 51
PROFIT OR LOSS (per acre)	-- 88	18 02	6 33
Value per bushel	$ 60	$1 07	$ 82
Net cost per bushel	65	84	74
Acres in potatoes	8 1	8 3	8 2
Yield per acre	92 2	128 0	105 9
Hours man labor	53 5	82 5	64 5
Hours horse labor	46 7	61 2	52 2
Hours tractor labor	1 4	2 3	1 7

The 33 farmers producing table stock potatoes averaged 8.1 acres per farm with an average yield of 92.2 bushels per acre. Figuring the costs as described in the preceding paragraph, there was a total cost of $60.15 an acre and of 65 cents for each bushel of potatoes. The value of the potatoes on December 1st of that year averaged $59.27 per acre, or 88 cents less than the cost of production. The 20 growers of certified seed had practically the same acreage as the preceding group, but had an average yield of 128 bushels per acre. This group had an average cost of $107.44 an acre and of 84 cents per bushel of potatoes produced. The certified stock had a total value of $125.46 an acre, consequently, there was a profit of $18.02 per acre.

A comparison of the two groups shows that the table stock men used 10.3 bushels of seed per acre, and the certified growers used 17.9 bushels. The seed value per bushel averaged $1.16 for the first group and $1.76 for the certified growers. Table stock producers averaged 159 pounds of commercial fertilizer per acre, while the other group used 456 pounds. The producers

of table stock potatoes spent 53.5 hours of man labor per acre. The certified growers averaged 82.5 hours of man labor and they also used more horse and tractor labor. The charge for spray material and for use of machinery and equipment averaged higher on the certified group.

Factors Affecting Yields and Costs

One of the most important phases of this project is the study of the factors responsible for the variations in yields and costs. In studying these factors, the farms were first sorted on the basis of yield per acre. The results on the table stock and certified growers are presented separately in Table 2, the same as in Table 1. Items thought to have an influence upon the yield per acre were calculated for the various groups and are shown in Table 2. This grouping of the farms on the basis of yield per acre, shows the relation of yield to total costs per acre, to cost per bushel and profit per acre.

Table 2.—Relation of yield per acre to costs and returns.

Items	Table stock			Certified seed		
Yield groups (bu.)	To 75	75–105	Over 105	To 125	125–150	Over 150
Number farms	11	12	10	7	7	6
Average yield	53.4	90.4	120.8	81.1	136.9	194.0
Acres per farm	6.7	7.4	10.6	9.9	7.8	7.0
Bushels of seed	10.2	9.0	11.5	16.1	18.8	19.6
Cost of seed per bushel	$ .94	$1.19	$1.28	$1.74	$1.87	$1.63
Number treating seed	7	9	7	7	7	6
Pounds of fertilizer	18.6	145.5	269.4	359.9	577.1	459.2
Acre costs:						
Man labor—growing	6.38	7.39	6.45	12.38	12.16	10.49
Cost of seed	9.54	10.71	14.71	28.01	35.10	31.91
Seed treating material	.31	.44	.58	.64	.49	.93
Spray cost	.47	.94	1.79	3.83	5.81	4.67
Green manure	1.27	1.45	1.71	.93	1.20	1.19
Barnyard manure	5.88	7.80	7.49	4.79	6.75	11.18
Commercial fertilizer	.42	3.13	5.75	8.15	13.06	9.40
Growing cost	37.03	44.69	54.65	82.07	97.69	94.67
Total cost	47.69	56.90	71.60	95.04	117.29	115.02
Income per acre	30.86	60.90	77.77	71.15	145.51	189.17
Profit per acre	—16.83	4.00	6.17	—23.89	28.22	74.15
Cost per bushel	.89	.63	.59	1.17	.86	.59

Items appearing to have a close relation to yield and cost, were used as the basis of another sorting in Table 3. In this Table showing the results on certified potatoes, the farms were grouped according to the amount of the particular item under consideration. This was done to determine as closely as possible the effect of each factor. In the mimeographed report returned to the cooperating farmers, there was a similar table showing the results on farms producing table stock.

A brief summary of the effect of the different factors for the one year on both the table stock and certified potatoes follows:

(1) The plowing under of green manure seemed to give good increases in yield in both cases, although the results show up irregular. (2) Barnyard manure apparently caused increased yields with the certified growers, but not with the table stock producers. (3) Commercial fertilizers resulted in higher yields in both groups. (4) Higher seed charges for each acre of potatoes seem to have been accompanied with higher yields, although the trend

Table 3.—Effect of different factors upon yields and costs of certified seed potato growers—1930.

Factors	Number farms	Costs and Returns per Acre									Net cost per bu.	Yield per acre	Acres
		Green manure	Barnyard manure	Com fertilizer	Total fertilizer	Spray material	Growing cost	Total cost	Income	Profit			
Green Manure:													
None.	3		$2 38	$9 37	$11 75	$4 71	$97 21	$110 85	$84 62	$—26 23	$1 41	78 8	7 8
To $1 25 per Acre	9	$0 88	8 22	10 80	19 90	4 78	92 15	109 43	137 48	28 05	76	144 5	8 1
Over $1.25 per Acre	8	1 65	7 41	9 57	18 63	4 64	86 26	104 14	126 65	22 51	82	127 5	8 7
Barnyard Manure:													
None....	1			9 01	9 01	3 92	87 27	97 72	48 52	—49 20	95	48 8	12 5
To $7.50 per Acre	9	1 07	4 96	11 54	17 57	4 63	88 87	105 61	107 09	1 48	92	114 4	9 1
Over $7 50 per Acre	10	1 28	10 66	8 60	20 54	4 90	92 69	111 15	159 75	48 60	71	157 3	7 2
Commercial Fertilizer:													
None	1	1 12	8 23		9 35	2 67	62 69	77 82	73 78	—4 04	1 09	71 4	5 3
To $10 00 per Acre.	12	1 01	7 09	7 68	15 78	3 97	84 85	101 53	120 70	19 17	83	121 8	8 4
Over $10 00 per Acre.	7	1 19	6 88	14 97	23 04	6 09	102 10	119 82	137 84	18 02	84	143 4	8 6
Seed Cost:													
To $25 00 per Acre.	6	1 46	6 50	6 45	14 41	4 09	69 81	86 73	106 26	19 53	78	111 2	8 5
$25 00 to $35 00 per Acre	5	76	6 49	8 92	16 17	3 57	91 20	103 74	110 28	6 54	99	104 4	8 9
Over $35 00 per Acre	9	1 01	7 79	13 42	22 22	5 84	104 71	124 60	148 75	24 15	80	154 9	7 5
Seed Treating Material:													
None	3	1 38	9 45	9 89	20 72	6 29	97 57	120 26	161 25	40 99	87	137 7	7 3
To $0 75 per Acre	8	1 11	9 18	9 65	19 94	4 46	88 63	102 87	112 77	9 90	83	123 6	7 6
Over $0 75 per Acre	9	98	4 84	10 45	16 27	4 45	89 80	107 34	125 24	17 90	83	128 7	9 2
Date of Planting:	Fields												(Per field)
Before June 1	5	1 57	7 01	11 40	19 98	4 11	89 25	105 65	134 28	28 63	79	133 3	7 6
June 1 to 10 . .	14	82	5 37	8 13	14 32	4 00	87 56	106 05	122 41	16 36	95	112 2	3 6
After June 10 .	8	92	5 18	12 58	21 68	5 84	96 51	111 40	92 44	—18 96	95	117 2	6 4
Spray Cost:	Farms												(Per farm)
To $3.50 per Acre	7	1 02	7 21	6 56	14 79	2 79	75 81	93 57	130 40	36 83	73	128 5	8 2
$3 50 to $5.25 per Acre	6	1 06	6 58	10 49	18 13	4 36	87 29	100 45	87 46	—12 99	98	102 6	10 2
Over $5 25 per Acre	7	1 18	7 46	13 78	22 42	7 42	111 91	132 96	168 21	35 25	83	160 0	6 8
Man Labor:		(Growing)	(Harvest)	(Horse L)	(Trac L)								
To $10 00 per Acre	5	8 48	10 29	8 61	1 42		82 70	102 27	151 66	49 39	65	158 1	8 9
$10 00 to $13 00 per Acre	8	11 08	7 63	6 99	3 55		84 04	100 03	108 40	8 37	88	113 1	8 5
Over $13 00 per Acre	7	15 60	9 06	12 63	54		105 01	121 22	125 42	4 22	99	122 0	7 6
		(G Man)	(B Man)	(Fert)	(T Fert)								
Fall plowing	5	1 05	6 29	13 51	20 83	5 64	104 00	124 58	171 68	47 10	.78	160 5	8 9
Spring plowing..	14	1 05	7 24	8 88	17 17	4 43	84 43	100 67	108 50	7 83	.85	118 1	7 6
Number factors above average.													
4 factors above average	6	1 36	7 77	14 38	23 51	7 35	110 14	130 42	164 77	34 35	81	161 4	6 9
3 factors above average	3	1 43	7 29	8 53	17 25	5 00	94 34	111 31	135 89	24 58	93	120 3	9 3
2 factors above average	9	82	7 27	10 04	18 13	3 82	85 43	99 75	106 72	6 97	83	119 6	8 2
1 factor above average	2	99	4 71	4 23	9 93	2 30	65 32	85 15	101 00	15 85	82	103 5	11 3

is irregular. This charge is dependent upon the spacing of the hills in the row and width of row, the size of the seed, and the value per bushel. It appears likely that those having the higher seed charges had closer spacing in the row and used higher quality seed. (5) The next comparison was on the price of the seed per bushel. It does not appear that this factor had much influence in 1930. (6) The amount spent for seed-treating material did not seem to have any relation to the yield on these farms in 1930. (7) Earlier planting appeared to improve the quality, as shown by higher value per bushel; this value was seven cents a bushel greater on table stock and 22 cents on certified seed. The net profit per acre was greater on the early plantings, due principally to difference in value per bushel. The potatoes planted prior to June 1st yielded the most with the certified growers and the least with table stock producers. The amounts of fertilizers applied, however, were heavier on late plantings in both cases. (8) It seems that the men spending the most for spray material got better yields. (9) The growers spending the least time per acre produced the most potatoes per hour of labor. The figures on trend of total yield and cost for table stock and for certified potatoes do not agree. (10) The growers having more than average charges in the largest number of six items (the three classes of fertilizer, seed, spray material, and labor) had higher average yields and lower costs than those having fewer items with more than average charges.

Summary

The 53 farmers keeping Potato Enterprise Records in the extremely unfavorable potato season of 1930 had an average yield of 105.9 bushels per acre. This compares with a State average of 58 bushels per acre for all producers. A complete statement of the expenses on these farms shows the total cost to be $78.18 an acre, or 74 cents a bushel. The value of the pototoes December 1, was $6.33 an acre more than the cost. The yield on these farms ranged from 24 to 248 bushels per acre. The cost varied from 41 cents to $2.00 a bushel. These men had 8.2 acres of potatoes on the average, and spent 64.5 hours of man labor on each acre.

The 33 table stock producers averaged 92.2 bushels of potatoes per acre, produced at a total cost of $60.15 an acre or 65 cents a bushel. On the basis of the value December 1, there was a loss of 88 cents an acre for each of the 8.1 acres of potatoes on each farm. These men on the average, used 10.3 bushels of seed per acre, 159 pounds of fertilizer, spent $1.15 an acre for spray material, and put in 53.5 hours of man labor on each acre.

The 20 certified seed growers had an average yield of 128.0 bushels per acre and a total cost of $107.44 an acre. The cost per bushel averaged 84 cents. The potatoes were worth $125.46, as an average for the 8.3 acres on each farm, so there was a profit of $18.02 an acre. The certified growers used 17.9 bushels of seed per acre, 456 pounds of fertilizer, spent $4.70 an acre for spray material, and spent 82.5 hours of man labor on each acre during the season.

SOURCES OF SOME ABNORMAL FLAVORS IN MILK

Prolonged Lactation Periods, Lack of Cooling, Improper Feeding Practices, and Copper Contamination May Result in Abnormal Milk Flavors.

G. MALCOLM TROUT, SECTION OF DAIRY HUSBANDRY

During the past year, many samples of whole milk were brought to the section of dairy husbandry for analyses of undesirable flavors. Previous complaints from customers of dairy companies had caused the companies to investigate the nature and the possible cause of the off-flavor in some instances. In other cases, the rejection of milk at milk receiving stations caused the inquiries. The regular inspection of city milk supplies also were responsible for the receipt of other samples, while installation of pasteurizing equipment and the introduction of the pasteurizing process in some plants in the State caused attention to be focused on the resulting flavor of the milk. In all, 122 samples of milk were scored for flavor.

Many of the samples of milk studied had off-flavors which would pass unnoticed, especially if the milk were cold. However, many of the abnormal flavors found were so intense as to give rise to complaints from customers. The causes of these flavors seemed to fall easily into four distinct groupings. These groupings were advanced stage of lactation of one or more animals in the herd, feeding of strong flavored feeds previous to milking, improper cooling of the milk, and either poor pasteurizing equipment or improper pasturization.

One patron's milk was rejected daily at the receiving station. A sample of this milk was tested at Michigan State College and it was found that the milk had an offensive odor and a rancid flavor, either of which would warrant its rejection. Inquiry revealed that the milk was a mixture of the milk from a herd of 11 cows. Samples of the evening's and morning's milk from each of these cows were obtained. Two samples had the same odor and flavor present in the mixed milk, and these samples were the evening's and the morning's milk from the one cow. Inquiry revealed that this cow had been in continuous lactation for 23 months. Other cases of similar off-flavors were encountered in which the cause appeared to be due to an extended lactation period, although not so extreme as the one given above.

Tests revealed a distinct "silage" flavor in samples sent by a producer whose milk had been repeatedly rejected. Milk from the individual cows showed that the undesirable flavor was being carried in the milk from two cows. Upon questioning, it was learned that these two cows were more nervous than the others and, consequently, were fed silage just previous to milking. The owner reported that the bad flavor was eliminated by a change in feeding practices. Several cases of flavors from feeds were observed. In

each case, feeding just prior to milking seemed to be the cause of the off-flavor.

Insufficient cooling of the milk seemed to be the primary cause of some off-flavors which were studied. In one case, the milk was being rejected daily. Examination showed that the temperature of the evening's milk had not been reduced below 65° F.

In one small, pasteurizing plant, pasteurized milk had a pronounced off-flavor which caused numerous complaints from customers. The examined pasteurized milk possessed a pronounced cardboard flavor, which was entirely absent in the milk just prior to pasteurization. Samples were secured from the pasteurizer, from the cooler, and from the bottler, and the flavors were compared to that of the raw milk. The off-flavor was apparent in the samples which had passed over the surface cooler, and were noticeably present in milk direct from the pasteurizer. Examination of the bottler, cooler, and pasteurizer showed them to be new and the sanitation very commendable but the copper of the recording thermometer arm which extended into the milk was exposed, the tin having been scraped off by daily removal and subsequent replacement in the pasteurizer. Copper in contact with milk has been shown to be the causative agent resulting in the development of the objectionable cardboard flavor in milk. When the exposed copper was kept out of contact with the milk during the pasteurization process, the trouble was eliminated.

IRRIGATING POTATOES WITH A POROUS CANVAS HOSE

Profitable Increases In Yields and Higher Percentages of First Grade Tubers Secured

O. E. ROBEY, SECTION OF AGRICULTURAL ENGINEERING

During the summer of 1931, an experiment was carried on by the section of agricultural engineering to determine the value of irrigating potatoes and of the practicability of porous canvas hose for distributing the water.

The summer of 1931 was extremely dry. Only *6.35 inches of rain fell during June, July, and August, 3.73 inches of which fell in June. Irrigation water was not applied to the experimental plots until about the first of August. The drought had already began to show its effects on the growth of vines; in fact, on one of the plots, the vines were turning brown.

The plots were selected about July 25th by staking off quarter-acre areas in fields located in various parts of the State. In each case, two plots as nearly identical as possible in appearance of vines and of soil type were selected.

No special preparation had been given the plots. The entire fields in which they were located had received the same seed, seed treatment, fertilizer,

*East Lansing Weather Bureau.

cultivation, and spraying. The plots were purposely selected with somewhat irregular topography to try out the canvas hose method of irrigation.

Four plots on which the experiment was carried out in its entirety were located at the Keystone Demonstration Farm, Howard City; W. Wiltse & Son Farm, Morley; and the Potato Experiment Station at Lake City. Other plots upon which partial application of water was made and from which incomplete data were obtained were located at the Kellogg Experiment Station, Battle Creek; Welfare Potato Field, Lansing; and Dr. H. B. Zemmer's farm, Lapeer. Some of the plots were planted with seed of doubtful origin.

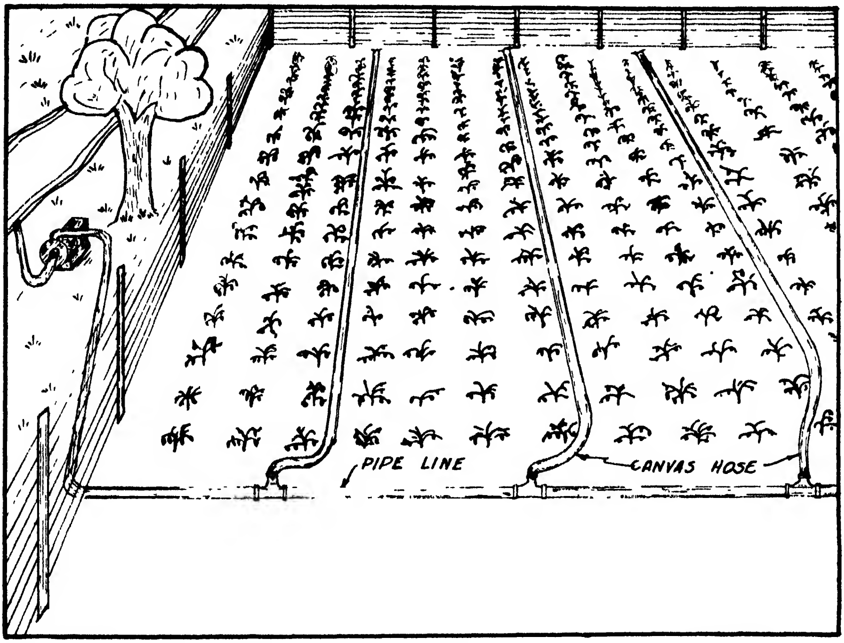

Fig. I.—Typical field layout of irrigation system.

Sources of Water

The water used for irrigating the various plots came from a variety of sources, streams, a lake, shallow wells, and city water mains. In each case, the water was applied directly to the crop without being warmed by exposure to the sun.

Method of Applying the Water

The method of applying the water on all the plots was by means of a porous canvas hose, except on small level portions where flooding was practical. The water was pumped from the sourse of supply by means of either a centrifugal or piston pump through iron piping to the edge of the plot where it was distributed by means of canvas hose laid in the rows. Figure 1 shows a typical layout of the distribution system used. The pipe line should be carried to the highest side of the field. The canvas hose

were attached to nipples in this pipe line and were laid between the rows of potatoes.

Operation

When the water is turned into the hose, it fills, due to the partial imperviousness of the fabric. When a slight pressure is built up, about four pounds per square inch, the water begins to ooze through the fabric. The amount of percolation through the canvas will vary somewhat depending on the lay of the land and the distance from the pipe line. In some cases, it is necessary to have sections of the hose of heavier weight material. For instance, when forcing water over a slight rise in the field, heavier canvas can be used on the pump side of the hill. Also on excessive down grades heavier canvas at the lower end will prevent undue leakage.

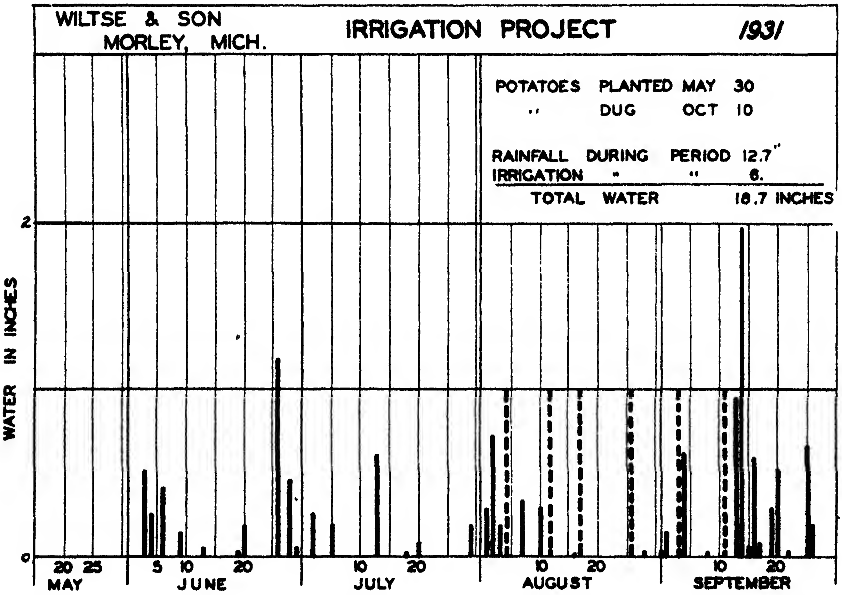

Fig. II.—Chart showing distribution of rainfall and irrigation water. Solid lines represent rainfall; broken lines, irrigation water.

In most cases, the hose lines were laid in each row and allowed to remain long enough to seep out the desired amount of water: Hose, in lengths up to 40 rods, were used without difficulty, especially when the field had a gentle slope downward. The water was carried over irregularities three feet high. The amount of water which will seep out of a length of hose depends upon the pressure. A hose 100 feet long will take all the water a 2,000 gallon per hour pump will deliver. If 400 feet or 600 feet of hose are attached to the same pump, the hose will simply deliver a smaller amount of water per foot of length. If the capacity of the pump is too small, the leakage of the hose may absorb the entire flow of water from the pump before it reaches the end of the hose. When this occurs, the seepage is not very uniform.

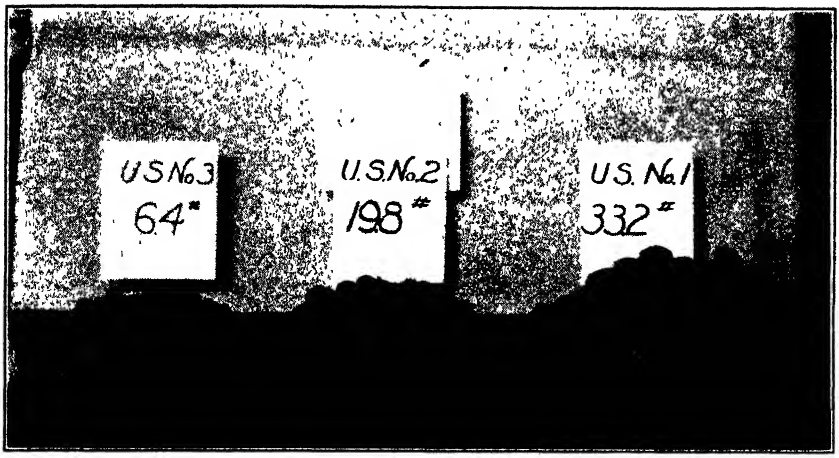

Fig. III.—Sample from one of the irrigated plots.

Rate of Application

Irrigation water equivalent to one inch of rainfall was applied each time These applications were repeated about one week apart. The plots, of course, received in addition to the irrigation water the rainfall which occurred during the period. Figure No. 2 shows graphically the amount of rainfall and irrigation water applied to one of the plots and also the distribution. Six inches of irrigation water on this plot gave an increased yield of 122 bushels of potatoes per acre.

Table No. 1 gives the rainfall, irrigation water, yield, and other data on the four plots.

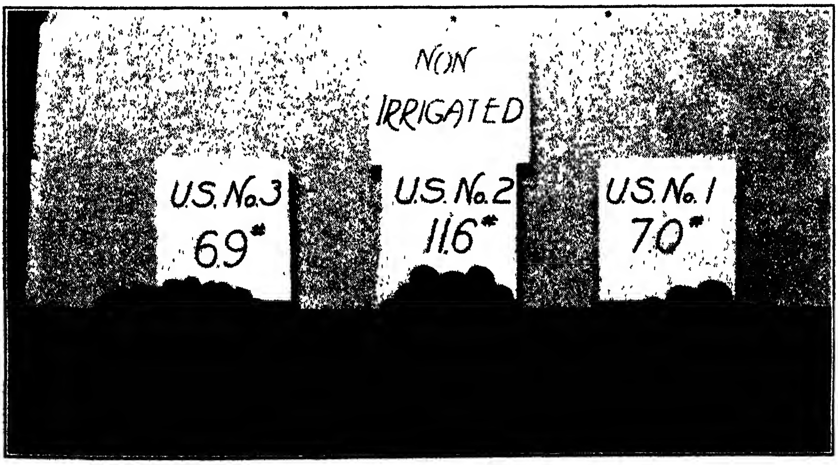

Fig. IV.—Sample from one of the unirrigated plots.

Table No. 1.

	Rainfall Inches	Irrigation		Total Rainfall and Irrigation	Yield in Bushels per Acre			
		No. applications	Inches		No. 1	No. 2	No 3	Total
Plot No 1·								
Irrigated.	11 71	6	6	17 71	249 2	31 68	22 4	303 28
Unirrigated	11 71			11 71	129 64	35 84	15 76	181 24
Increase....					119 56	—4 16	6 64	122 04
Plot No. 2:								
Irrigated	10 51	4	4	14 51	80 895	41 999	17 73	140 602
Unirrigated.	10 51			10 51	22 385	35 436	16 25	74 07
Increase..					58 510	6 563	1 48	66 532
Plot No. 3:								
Irrigated ..	10 51	4	4	14 51	145 018	31 883	9 498	196 080
Unirrigated..	10 51			10 51	28 496	28 677	11 435	68 607
Increase					116 522	3 206	—1 937	128 483
Plot No. 4:								
Irrigated	14 66	7	7	21 66	204 40	18 31	6 69	229 4
Unirrigated	14 66			14 66	101 15	19 36	4 36	124 81
Increase.					103 25	—1 05	2 33	104 53

By referring to Table No. 1 it will be noted that the largest increase was in No. 1's, which of course was desirable. There did not seem to be any tendency toward unevenness or ill-shaped tubers. Figs. 3 and 4 shows samples of potatoes from irrigated and unirrigated plots and shows the comparative smoothness of the two samples as well as the relative production of the two plots.

RATIONS FOR RABBITS COMPARED IN TESTS

Feed Costs Are Reduced by Substituting Ground Oats For Ground Oatmeal

R. A. CONOLLY AND C. G. CARD, SECTION OF POULTRY HUSBANDRY

This experiment was conducted to determine: (1) the comparative value of ground oats in a rabbit ration; (2) the value of alfalfa leaf meal in the ration; (3) the value of an increased fiber content of the ration; and (4) the comparative values of commercial pellet rations and of home-mixed rations.

Feeds and Methods

All lots were fed in steel hutches with wire floors in one of the laboratories of the poultry research building. Lot 8 was fed a commercial mash in pellet form and water was supplied in open dishes. All other lots received rations which were wet to a consistency of porridge. No additional water was given to lots which were fed this ration. The amount of feed given de-

pended upon the rabbit's appetite, as they were fed all they would clean up once a day. All lots were supplied with alfalfa hay in racks from which they could feed at will. The rabbits used were weaned from the doe at six weeks of age.

Table No. 1.

	Lot 1	Lot 2	Lot 3	Lot 4	Lot 5	Lot 6	Lot 7*	Lot 8
Ground corn	10	10	10	10	10	10	15	Commercial Pellets
Ground barley	10	10	15	15	10	10	15	
Ground oatmeal	35		35	35	35			
Wheat bran	20	20	15	15	20	20	25	
Linseed oil meal	10	10	10	10	10	10	10	
Dried skim milk	15	15	15	15	15	15	10	
St. bone meal	1	1	1	1	1	1	1	
Charcoal	5	5	5	5	5	5	5	
Salt	25	25	25	25	25	25	25	
Cod liver oil	5	5	5	5	5	5	5	
Alfalfa leaf				5	5	5		
Ground oats		35			35	20		
Gluten						5		
Average initial weight	2 10	1 88	2 06	2 45	1 88	1 77	1 57	1 7
Average final weight	5 10	5 35	5 76	5 57	4 84	5 22	4 06	5 0
Average gain per rabbit	2 70	3 47	3 70	3 12	2 96	3 45	2 49	3 2
Average daily gain per rabbit	0482	062	066	0557	053	0616	0508	057
Total hay consumed lb	7 61	7 62	7 88	7 61	7 62	7 88	5 62	7 6
Daily hay consumed lb	136	136	140	136	136	140	115	13
Price of hay per lb	$ 007	$ 007	$ 007	$ 007	$ 007	$ 007	$ 007	$ 00
Total hay cost	$ 053	$ 053	$ 055	$ 053	$ 053	$ 055	$ 039	$ 053
Daily hay cost	000952	000952	00098	000952	000952	00098	000805	00095
Total mash consumed	9 20	9 14	9 85	9 77	9 42	9 33	7 01	9 6
Daily mash consumed	161	163	175	174	168	166	143	17
Price of mash	$1 76	$1 59	$1 76	$1 77	$1 76	$1 60	$1 65	$3 0
Total mash cost	$ 1619	$ 1453	$ 1733	$ 1729	$ 1658	$ 1493	$ 1157	$ 288
Daily mash cost	00288	00259	00309	00308	00295	00266	00236	005
Total feed consumed	16 81	16 76	17 73	17 38	17 04	17 21	12 63	17 3
Total feed cost	$ 2149	$ 1988	$ 2285	$ 2259	$ 2193	$ 2043	$ 1552	$ 341
Feed consumed per lb. gain	6 23	4 83	4 79	5 57	5 75	4 87	5 07	5 3
Feed cost per lb. gain	$ 0795	$ 0572	$ 0617	$ 0724	$ 074	$ 0592	$ 0623	$ 106

*One rabbit died in this lot so the experiment was concluded at 7 weeks

The information collected to date should be considered as a progress report. Experimental work is being continued and a definite ration will be recommended in the near future. Attention should be called to the fact that the results reported in Table 1 were obtained from a small number of rabbits. Repeat tests however, have given the same general results and the following conclusions seem to be justified.

Summary

1. By substituting ground oats for ground oatmeal the cost of the ration was reduced 17 cents per hundred. The ground oatmeal ration produced the greater gains but the increased mash consumption and increased price made the cost per pound of gain, higher than the ground oats ration.

2. The addition of alfalfa leaf to three different rations produced greater rabbit gains in one ration only. The cost per pound of gain was considerable more by using alfalfa leaf in the ration.

3. Increasing the fiber content of the ration by substituting 5 per cent of bran in place of 5 per cent of barley resulted in less gain and increased cost per pound of gain.
4. The commercial mash compared very favorably with other mixtures. The commercial mash in pellet form made satisfactory gains but the feed cost was so high that the cost per pound of gain was very high.

FEEDING DIFFERENT AMOUNTS OF PROTEIN TO GROWING TURKEYS

Light Birds Have Poorer Finish and Higher Losses in Dressing

J. M. MOORE, SECTION OF POULTRY HUSBANDRY

Opinions differ as to what constitutes a satisfactory starting mash and growing feed for turkeys. Many turkey growers in Michigan have had very successful results in raising their turkeys on baby chick starting mashes and growing mashes. Others believe that turkeys need a higher protein content in their developing ration, if they are to make a maximum gain and produce a well finished carcass at the Christmas season. To determine the optimum amount of protein in the growing ration of young turkeys, this study was made at the Michigan Experiment Station during the spring and summer of 1931.

The Poultry Department had seven hens and two toms in their breeding flock. These birds were of the Bronze breed. The eggs from this flock were set every two weeks and as the poults were hatched out they were put on experiment. It would have been more satisfactory to have had all poults in the experiment the same age, but this was impossible.

No special equipment was used in the brooding of these poults. The brooders were located in the service building of the poultry research plant. These brooders were home-made and had electric lights to supply the necessary heat. Whenever the weather was suitable, the poults were put outside in small runs with a shelter from rain. They were again brought into the service building at night. This method of brooding was followed until they no longer needed heat. They were then put out in small yards with only a roof to protect them from the rain.

During the first 10 weeks of their life, their pens were moved every week. These pens were located on alfalfa sod, and the poults had plenty of green succulent feed. When they were 10 weeks old, the four lots of turkeys were put in a two-acre plot which was divided into four pens of equal size, each pen being one-half acre in area. They were kept in these runs until Thanksgiving time when they were killed for market.

During the first week of brooding, the poults were fed, in addition to their mash, a custard made by cooking eggs and milk together. Many people have difficulty in teaching young poults to eat and it was for this reason that the custard was given them, as they seemed to like it; and, by first learning to

eat the custard readily, they soon became accustomed to eating the mash and the custard was omitted at the end of the first week. While the poults were being kept in home-made brooders in the service building, they were also fed plenty of green succulent alfalfa along with the mash. As soon as they were put out on limited range, they were fed only the mash and given water to drink. Succulent alfalfa for green feed was always before them. This mash was the only feed given them until two weeks before they wert killed. Then scratch grain, consisting of equal parts of cracked corn and wheat, was included in the ration. All feed was fed in hoppers; none was placed on the ground at any time.

Two-inch poultry netting was placed between the perches and the dropping boards so that the turkeys could not gain access to the droppings at any time. The mash hoppers and the water fountains were moved once a day in order to keep the soil around them as sanitary as possible.

In choosing the rations, it was thought desirable to select one that had proved successful in raising baby chicks. The Spartan Chick Starter was chosen for this reason and was fed to Lot No. 3; Lot Nos. 1, 2, and 4 were fed modifications of the Spartan Chick Starter. The meat scrap and dried milk were increased, and the ground corn content was decreased in order to hold the total to 100 pounds. The only departure from this procedure was in Lot 4 where the 2 pounds of steamed bone meal was left out. As this ration contained 25 per cent of meat scrap, it was thought that the poults would receive enough of the bone meal content from the meat scrap Table 1 gives the percentage of crude protein in each of the four rations Though we believe that at least one, and perhaps two, of these rations contain too high a percentage of animal protein, it was desired to find out definitely if it would have any detrimental effect on the turkeys. No bad effects were noticed except that one turkey in Lot 4 developed a slipped tendon. This condition is often seen in baby chicks that have been raised in storage batteries. With the exception of this one bird, no bad results were noticed.

Lot No. 1 was fed the following ration:

28 pounds ground corn	12 pounds dried skim milk
20 pounds ground oatmeal	5 pounds alfalfa leaf meal
20 pounds flour middlings	2 pounds steamed bone meal
12 pounds meat scraps	1 pound salt

Lot No. 2 was fed the following ration:

17 pounds ground corn	15 pounds dried skim milk
20 pounds ground oatmeal	5 pounds alfalfa leaf meal
20 pounds flour middlings	2 pounds steamed bone meal
20 pounds meat scrap	1 pound salt

Lot No. 3 was fed the basal ration known as the "Spartan" Chick Starter:

37 pounds corn meal	10 pounds dried skim milk
20 pounds flour middlings	5 pounds alfalfa leaf meal
20 pounds ground oatmeal	2 pounds steamed bone meal
5 pounds meat scrap	1 pound salt

Lot No. 4 was fed the following ration:

14 pounds corn meal	15 pounds dried skim milk
20 pounds ground oatmeal	5 pounds alfalfa leaf meal
20 pounds flour middlings	1 pound salt
25 pounds meat scrap	

Table 1.—Percentage of crude protein in rations

Lot Number	1	2	3	4
Percentage Crude Protein	20 716	25 12	17 04	28 08

As the ages of the four lots of turkeys were different, it was necessary to make a comparison of the growth at the end of the twenty-second week, and Lot No. 4 (the youngest) was killed the following day. Weights were taken of each individual bird at weekly periods, and in Table 2 is shown

Table 2.—Weights at 22 weeks of age

Lot Number	1	2	3	4
Weight per bird in pounds	11 03	11 29	10 32	11 51

the average weights of the four lots at 22 weeks of age. It will be noticed that the birds of Lot No. 4, which is the high protein pen, averaged 1.19 pounds more than those of the low protein lot; and, as would be expected, Lots 1 and 2—the intermediate lots—were intermediate in weight.

Table 3.—Dressing records of the birds under experiment.

Lot Number	1	2	3	4
Age at which birds were killed (in weeks)	28	25	23	22
Live weight per bird at killing (pounds)	14 97	12 76	10 93	11 51
Dressed weight per bird (pounds)	13 58	11 65	9 84	10 32
Drawn weight (pounds)	11 19	9 68	7 58	8 33
Percentage lost in dressing (live weight)	9 3	8 7	10 0	10 0
Percentage lost in drawing (live weight)	25 2	24 1	30 6	27 6
Percentage lost in drawing (dressed weight)	17 6	16 9	23 0	19 3
*Average grade of carcass	1 25	1 77	3 00	1 83

*The grading of the carcasses was done after the birds were dressed. Four tentative grades were set up for the sake of comparison only. One man did the grading. The explanation of the grades follows:

Grade I. Well finished carcass with a suitable amount of fat showing in the skin and a well rounded out breast.
Grade 2. A carcass showing a fair degree of finish, but one inferior to Grade 1.
Grade 3. A carcass showing little finish with a skin rather bluish in color. Poor development of breast meat.
Grade 4. A thin unfinished carcass. One which is undesirable in appearance and has little meat on the bones and what meat there is present is of a very poor quality. A thin breast showing no indication of finish.

NOTE:—In grading, no cuts were made in score because of poor dressing of the birds. The carcasses were judged as though they had all been dressed without injuring the skin in any way. Presence of pinfeathers in the dressed carcasses was noted as this is an indication of an unfinished condition.

At the close of the experiment, the birds were killed, dressed, and drawn. Before killing, they were starved for 24 hours and were weighed just before killing. After they were killed and the feathers had been removed, the birds were again weighed. This is called the dressed weight. They were then hung up in the refrigerator until they had become thoroughly cooled and were then drawn. In drawing the carcasses, the legs were cut off at the hock and the internal organs were removed. The neck, the heart, the gizzard, which had the contents removed, and the liver were then replaced in the carcass before weighing. In fact, the drawn carcass was the carcass as one would put the dressing in before roasting.

In Table 3, the information is given regarding the weights before and after killing. It is interesting to note that, though the individuals of Lot 4 were younger than those of Lot 3, Lot 4 had a smaller loss in weight from drawing than did Lot 3. In comparing two lots of growing turkeys that were being fed the same feed, one would expect a greater loss from drawing in the younger birds as they would be in a more unfinished condition, and yet we see that Lot 4 showed more finish than Lot 3. This condition was also very noticeable in the grading of the carcasses. Though Lot 4 graded 1.83, the average of all the carcasses in Lot 3 was grade 3, showing that the birds were thin, and that they had not begun to put on the necessary fat which goes with a well-finished bird.

In Table 4, another classification has been made of the carcasses. Taking the whole four lots fed on different feeds, the carcasses were sorted by weight. Those carcasses in which the live bird weighed six to eight pounds being Class No. 1 and those from eight to ten pounds being in Class No. 2, it may be seen that the lightest turkeys suffered the greatest losses in both dressing and in drawing. A turkey of this type is not finished and is a poor investment for the buyer. It can be seen from Table 3, that as the weights go up, the percentages of losses in dressing and in drawing the car-

Table 4.—Classification of carcasses by weight.

Live weight of carcasses	6–8	8–10	10–12	12–14	14–16	16–18	18–20	20–22
Live weight	7.5	8.7	10.7	12.7	15.2	16.8	18.5	21.6
Dressed weight	6.6	7.7	9.6	11.5	13.7	15.3	16.8	19.7
Drawn weight	5.0	6.1	7.6	9.4	11.4	12.8	13.9	17.0
Percentage loss in dressed weight	13.3	11.4	10.3	9.4	9.9	8.9	9.2	8.8
Percentage loss in drawn weight (live weight)	33.3	30.0	29.0	26.0	25.0	23.8	24.9	21.2
Percentage loss in drawn weight (dressed weight)	24.2	20.8	20.8	18.3	16.8	16.3	17.2	13.7
Average grade carcass	3.8	2.3	1.6	1.9	1.9	1.7	1.4	1.0
Number birds in each lot	5	6	14	8	7	7	5	1

casses decrease as the weights increase. It may also be seen that, as the weight increases, so does the grade. Of course, young hen turkeys do not weigh as much as young toms; however, if one is raising Bronze turkeys and obtains a top price on the open market, he must have turkeys that average 10 pounds or more.

Table 5.—Number pounds feed to produce 1 pound gain at 22 weeks.

Lot Number	1	2	3	4
Number of pounds feed for 1 pound gain	4 821	4 266	5 050	3 668

As seen in Table 5, the highest protein ration produced one pound of turkeys for the least amount of feed. It would depend on the spread in price between the animal supplement and the other ingredients in the ration whether Lot 4 made the most economical gains.

Discussion of Results

1. The ration containing 17.04 per cent of protein did not produce the weight nor the quality of meat that either of the other three rations did.
2. Because of the differences in age, and the small differences in weight of Lots 1, 2, and 4, no definite conclusions can be drawn at 22 weeks of age as to which ration is the most satisfactory, although Lot 4 did make the best gain on the least amount of feed.
3. The low protein ration (Lot No. 3) produced the poorest quality carcass, even although Lot 4 was younger when killed.
4. In turkeys of the Bronze breed, every bird killed should weigh at least 10 pounds in order that the carcass may show a satisfactory finish.

RATIONS FOR FATTENING BEEF CALVES

Give Final Report on Feeding Trials Made at Michigan State College

G. A. BRANAMAN, SECTION OF ANIMAL HUSBANDRY

PART I

The Farm Grains—Corn, Barley, and Oats Compared

The data presented in this article represent the second experiment at the Michigan Agricultural Experiment Station in which ground barley, shelled corn, and ground oats are compared. Each lot of calves received pea-size linseed cake, corn silage, and alfalfa hay in addition to the respective farm grain.

Methods of Feeding

The feeding period began December 9, 1930, and continued 196 days or until June 23, 1931. Approximately one pound of linseed cake was fed to each seven pounds of grain. About six and one-half pounds of this grain mixture per calf per day was fed the first two months, eight pounds the next two months and 12 pounds the last two months. The calves in the corn lot cleaned up the grain more readily the last few weeks and were given a larger allowance. They ate 14 pounds per day the last two weeks. All the silage which the calves would eat readily was fed twice daily, and hay racks were kept filled with alfalfa hay. A mixture of equal parts of bone meal and salt was kept in one end of the mangers.

Quality of Feeds

The grains were purchased on the market in car lots, the corn tested 12 to 14 per cent moisture; the oats weighed 32 pounds; and the barley 46 to 48 pounds per bushel. Linseed cake was the usual 34 per cent old process product.

Silage grown on the College Farm yielded seven to eight tons per acre, with approximately 35 bushels of corn per acre and was harvested in the denting and glazing stage. The alfalfa hay was first cutting and varied in quality, some was coarse and stemmy with light mixtures of timothy and blue grass. All the hay was purchased near Lansing.

Description of Calves

Native Michigan calves from grade white-faced cows and sired by registered Hereford bulls were purchased in Sanilac County. Fifty head were sorted from a crop of 90 calves for use in Parts 1 and 2 of the experiments here reported. Five steers and five heifers were used in each Lot and sorted carefully according to the usual methods. With few exceptions all were of choice feeder grade.

Valuations

Price factors are, of course, variable in connection with any experimental feeding results. Actual cost of the calves, which approximates also the cost of similar western calves delivered in Michigan, is used in computing results. Market experts from Detroit and Buffalo markets placed values on the finished cattle. Eighty-five cents per hundredweight was deducted for expense and shrink.

Approximate costs of feeds in sections of Michigan near Lansing during the period of the experiment have been used. Supplementary revaluations have been added to represent conditions nearer those in the fall and winter of 1931-32.

Pigs Help Corn-fed Calves

Difficulty was experienced with unthrifty pigs in all lots so that pork credits are practically negligible in the ground barley and ground oat lots. The relative differences between lots, however, are similar to past experiences with shelled corn compared with ground grains.

Table 1.—Weights, feeds, and costs.

	December 9, 1930—June 23, 1931 196 days		
	Lot 1	Lot 2	Lot 3
	Ground barley	Shelled corn	Ground oats
Number calves per lot	9	10	10*
	(Pounds)	(Pounds)	(Pounds)
Initial weight per calf	373.7	366.4	362.7
Final weight per calf	815.5	791.3	783.7
Total gain per calf	441.8	424.9	421.0
Average daily gain	2.25	2.17	2.15
Average daily ration:			
Ground barley	7.4		
Shelled corn		7.6	
Ground oats			7.4
Linseed meal	1.1	1.1	1.1
Corn silage	15.3	15.2	15.3
Alfalfa hay	2.6	2.5	2.0
Feed per cwt. gain:			
Ground barley	328.7		
Shelled corn		351.5	
Ground oats			344.1
Linseed meal	48.9	51.3	51.3
Corn silage	676.8	702.5	709.0
Alfalfa hay	116.5	115.4	92.7
Feed cost per cwt. gain	$7.07	$7.43	$7.23
Pork credit per calf @ $7.00 per cwt.	.10	1.14	18
Feed cost per cwt. gain (crediting pork)	$7.04	$7.16	$7.18
Initial cost in lots per cwt.	$11.25	$11.25	$11.25
Initial cost in lots per calf	42.04	41.22	40.80
Feed cost per calf	31.23	31.57	30.42
Cost of calf plus feed cost	73.27	72.79	71.22
Necessary selling price in lots to break even (crediting pork)	8.98	9.05	9.06
Selling price per cwt. in lots	7.55	7.40	7.45
Selling price in lots per head	$61.57	$58.56	$58.39
Loss per head crediting pork	$11.60	$13.09	$12.65

Prices of feeds:

All grains $1.12½ per cwt. No charges for grinding. (Ground barley 54 cents per bushel, shelled corn 63 cents per bushel, ground oats 36 cents per bushel) linseed meal $40.00 per ton, silage $5.00 per ton, alfalfa $12.00 per ton, tankage $2.75 per cwt., pork credited at $7.00 per cwt.

*NOTE:—1 calf in lot 3 died April 15th. The average gain and feed per calf after that time was added.

Table 2.—Revaluations at lower prices.

	Lot 1	Lot 2	Lot 3
Initial cost per calf at $7.50	$28.03	$27.48	$27.20
Cost of feed per calf*	22.15	22.35	21.49
Total cost of calf and feed	50.18	49.83	48.69
Pork credit per calf at $4.50		.71	
Necessary selling price per cwt., to pay for calf and feed	6.15	6.20	6.21

*Prices of feeds:

Grain $0.75 per cwt., linseed $25.00, silage $4.00, alfalfa $10.00.

Summary

1. The barley-fed calves gained slightly faster than either of the other lots, with no difference between corn and oat-fed calves. This is unusually good for oat-fed calves.

2. The difference in feed cost for each hundred pounds gain on the calves is slight, with barley having the edge. The pigs in the corn-fed lot salvaged sufficient corn to make the cost of gain even with the oat lot.

3. The barley-fed calves were slightly fatter than those in the other lots and were valued slightly higher by representatives of the Detroit and Buffalo markets. The oat-fed calves were given a choice over the corn-fed calves, which was an unusual occurrence. Returns per head were in proportion to the market values.

4. Charges for grinding the barley and oats would change their relationship as compared with corn. Ten cents charge per 100 pounds of grain fed would put barley and corn on an equal basis and give oats a slight handicap. It should be noted the barley and oats were both heavy in test weights and lighter weight products are less efficient feeds.

5. The necessary selling price shows that the calves could have sold at a price $2.20 below the initial cost per hundredweight and still pay for the feed at prices charged in Table 1. Steadily declining prices during the year resulted in a loss in all lots.

6. At the lower scale of prices in Table 2, a cost price of $7.50 per hundredweight for the calves and a selling price of $6.15 to $6.20 would pay for the feed. Calves produce much cheaper gains than older cattle, as many experiments have shown; otherwise, a margin over cost price would be necessary to pay feed costs.

7. Credits for manure and overhead expenses, such as interest, taxes, and labor, will affect the net returns from cattle feeding in various ways, depending on the individual conditions on each farm.

PART II

A Study of Winter Rations for Calves to be Marketed the Following September

Higher prices on the average may be expected for well finished cattle in the fall months than in the spring. Some farmers feed through the summer with this market in view, though most cattle are fed during the winter and spring. The question naturally arises as to how long and how well should calves weaned in the fall be fed for such a market. This report gives the results of the second experiment along this line conducted at the Michigan Station.

Methods of Feeding

The feeding period began December 9, 1930 and continued 293 days, until September 28, 1931. The source and description of calves was given in Part 1 of this report. The feeds were the same quality as described in Part I. Silage was discontinued in all lots the last month

due to filling the silo. It was noted that the appetites of the cattle became unsettled and there was a tendency to scour after silage in the ration was dropped.

The oat-fed lot of the experiment in Part I constituted Lot 3, the well-fed lot. After June 23, the ration was changed from oats to shelled corn and a full feed continued until September 28.

Lot 4 was given all the silage and alfalfa hay they cared for and enough corn in addition to keep them gaining slightly in flesh the first four months. After that, the corn was increased and linseed meal added to make a full feed.

Lot 5 had a full allowance of alfalfa with half a feed of silage the first four months. Corn, linseed meal, and silage were then brought to a full feed.

Table 3.—Weights, feeds, and costs in first period—Dec. 9, 1930-April 14, 1931—126 days.

	Lot 3	Lot 4	Lot 5
Number calves per lot	10*	10	10
	(Pounds)	(Pounds)	(Pounds)
Average daily ration.			
Ground oats.	6 16		..
Ground corn		2 36	.
Linseed cake	.88		
Corn silage	14 80	17 00	8 60
Alfalfa hay	1 67	4 10	8 68
Average initial weight	362 7	363 5	366.6
Average final weight	616 5	543 3	490 0
Average daily gain	2 01	1 43	.98
Cost per cwt. gain	$6 64	$6 61	$7 51

*1 calf died in lot 3 April 15th. Average gain and feed for 9 calves added to June 23rd A similar calf from lot 2 was put in ot 3 June 23rd.

Valuations

The same methods of evaluating the cattle were used as explained in Part I. The same prices for feeds were used, namely: grain at $1.12½ per hundredweight, linseed cake $40.00 per ton, silage $5.00 per ton, alfalfa $12.00 per ton, pork credit $7.00 per hundredweight. Lower price levels were also used to get a comparison as indicated in Table 7.

Table 4.—Weights, feeds, and costs in second period—April 14-June 23, 1931—70 days.

	Lot 3	Lot 4	Lot 5
Average daily ration	(Pounds)	(Pounds)	(Pounds)
Ground oats	9 61		
Shelled corn		4 24	5 36
Linseed cake	1 51	.60	1 01
Corn silage	16 00	19 81	18 82
Alfalfa hay	2 56	5 84	5 44
Average final weight	783 7	680 6	635 5
Average daily gain	2 39	1 96	2 08
Cost per cwt. gain (crediting pork)	$8 00	$7 10	$7 43

Table 5.—Weights, feeds, and costs in third period—June 23-Sept. 28, 1931—97 days.

	Lot 3	Lot 4	Lot 5
Average daily ration:	(Pounds)	(Pounds)	(Pounds)
Shelled corn	13 69	12 48	14.42
Linseed cake	1 96	1 69	1 92
Corn silage	10 20	11 96	11.53
Alfalfa hay	2 89	3 54	2.92
Average final weight	960 2	891 6	862 7
Average daily gain	1 82	2 18	2 34
Cost per cwt. gain (crediting pork)	$11 58	$9 23	$9 50

Light Ration Expensive

The calves in Lot 5 were fed a lighter ration than was fed in this lot the previous year. At the end of four months, they were thin but reasonably thrifty in appearance. Their gains were so low, that the cost for each pound of gain was higher than the cost for the calves fed more liberally. As between Lots 3 and 4, the cost of gain was practically the same in each case.

At the end of the next 70 days on more liberal feed, Lots 4 and 5 showed lower feed costs for gain than the full-fed calves in Lot 3. The amount of gain in Lot 3, however, was enough greater to more than pay the difference in cost. The gains of the lighter weight calves in Lot 5, although rather rapid on more liberal feed were still more expensive than those in Lot 4.

Gains made by the full-fed group in Lot 3 during the last three months period were relatively costly. The other two lots that were approaching choice grade in finish were gaining much more economically than those approaching a prime finish. The rate of gain was also much slower with increased finish. The lighter weight calves in Lot 5 were still more expensive in gains than those in Lot 4.

Table 6.—Gains, feeds, and costs entire experiment—Dec. 9, 1930-Sept. 28, 1931—293 days.

	Lot 3	Lot 4	Lot 5
	(Pounds)	(Pounds)	(Pounds)
Total gain per calf	597 5	528 1	496 1
Average daily gain—293 days	2 04	1 80	1 69
Total feed per calf:			
Ground oats	1449		..
Corn	1327	1804	1767
Linseed cake	406	210	256
Corn silage	3974	4690	3520
Alfalfa hay	671	1269	1758
Total feed cost per calf	$53 32	$43 83	$44 35
Pork credited per calf	2 63	2 73	2.68
Feed cost per cwt. gain	8 92	8 30	8.94
Feed cost per cwt. gain (crediting pork)	8 48	7.78	8 40
Initial cost in lots per cwt	11 25	11 25	11.25
Initial cost per calf	40 80	40 89	41.24
Cost of calf plus feed cost (crediting pork)	91.48	81.99	82 91
Necessary Selling price (crediting pork)	9 53	9.20	9.61
Selling price in lots	10 00	9.60	9.40
Return per head above calf and feed costs	4.53	3 60	—1 82

Table 7.—Costs on basis of lower prices.

	Lot 3	Lot 4	Lot 5
Initial cost per calf in lots at $7.50	$27 20	$27.26	$27 49
*Cost of feed per calf	37 20	31 88	32 28
Pork credit per calf	1 41	1 70	1 67
Necessary selling price in lots to pay for calf and feed (crediting pork)	6 56	6 44	6 73

*On basis of feed prices as follows:
Grain 75 cents per cwt., Linseed $25.00 per ton, Silage $4.00 per ton, Alfalfa $10.00 per ton, Pork credit at $4.50 per cwt

A summary of the entire feeding period of 293 days brings to the balance sheet final figures totaling cost of calves, cost of feed, value of pork produced from droppings, and selling value of the cattle.

Summary

1. Gains were in proportion to the quality of the rations.
2. About 50 per cent more total grain per head was consumed in Lot 3, but much less hay than either of the other lots and somewhat less silage than Lot 4. Though Lot 4 ate more silage than Lot 5 they ate less hay.
3. Feed cost for gains was lowest in Lot 4 where the calves had a small amount of grain during the winter. The other two lots were practically equal in cost of gains.
4. Necessary selling prices to pay for feed and calf cost gave Lot 4 a slight advantage. Lot 5 was the most expensive.
5. Market valuation was highest for Lot 3 and lowest for Lot 5, giving Lot 3 and Lot 4 a little margin above costs and Lot 5 a slight loss.
6. On the basis for lower prices, as indicated in Table 7, which more accurately represents present conditions, a reasonable margin could be expected from calf feeding after other necessary expenses, such as interest and other overhead costs were paid, and especially on most farms which need large quantities of manure to maintain soil fertility economically.

FERTILIZER EXPERIMENTS WITH SEED AND FIBER FLAX IN CHIPPEWA COUNTY*

B. B. ROBINSON AND A. G. WEIDEMANN, SECTIONS OF FARM CROPS AND SOILS

The production of flax at the present time is limited in Michigan. Fiber flax is grown only on a very small scale, its culture being confined primarily to Sanilac and St. Clair Counties, but, in the past few years, farmers in a few counties in the State, especially in Chippewa

*Fiber flax investigations are conducted at the Michigan Experiment Station under a cooperative agreement with the U. S. D. A., Bureau of Plant Industry, Office of Fiber Investigations.

county, have shown an interest in growing seed flax on a larger scale than previously. It is being grown as a cash crop in many instances to replace timothy hay. As a result of this interest, both fiber flax and seed flax were included in crops and soil fertility experiments conducted by the Michigan Agricultural Experiment Station on a farm located a few miles south of Sault Ste. Marie, Michigan.

Experimental plots were located on a heavy clay soil of the Ontonagon type which covers a large area in Chippewa County. The land in this area is generally level and poorly drained. The soil is acid on the surface, but well supplied with lime at a depth of 20 to 30 inches. Flax was grown upon this soil in 1928, 1930, and 1931, with such crops as barley, oats, peas, alsike, and June clover. Lime was applied to the lime plots in 1927 at the rate of three tons per acre in the form of limestone screenings. Whenever flax was grown, it was fertilized with 300 pounds per acre of one of the various commercial fertilizers shown in Table I. The fertilizer was broadcast and worked in just before sowing the flax. Light applications of barnyard manure were plowed under on two plots in the fall preceding flax. The seed flax was drilled at the rate of 40 pounds of seed per acre and the fiber flax at the rate of 84 pounds of seed per acre. In 1928, flax followed a timothy sod. In 1930, one series of seed flax was preceded by alsike clover and the other series of seed flax and the fiber flax series were preceded by June clover. In 1931, the flax was preceded by June clover. At maturity, samples were taken from each fertilizer plot and sent to East Lansing, Michigan, where yields were calculated for unthreshed straw, threshed straw, and fiber in pounds per acre and for seed in bushels per acre. The threshed straw from fiber flax plots was retted and scutched in order to determine the fiber yields but no fiber yields were determined for the seed flax.

The summarized data showing the yields obtained from various fertilizer treatments are shown in Table 1. Data are given in this table upon the yield of unthreshed straw, threshed straw, seed, and fiber per acre. In 1928, there were no manured plots. As a result, there was one less harvest from manure treatments than from the commercial fertilizer treatments. In the case of seed flax, there were two series of plots grown in 1930; so one column in Table 1 is headed, "average of four harvests," and the other is headed, "average of three harvests," because there were no manure treatments in 1928 to be averaged. The treatments were the same for fiber flax except that there was one less harvest of fiber flax in 1930 than of seed flax. The data in this table show that the fertilizers increased the yields of unthreshed straw and threshed straw but did not noticeably increase the yields of seed in most instances. As the fiber is obtained from the straw, an increase of fiber was also obtained with certain fertilizer applications to the fiber flax.

The response of flax to superphosphate alone is not encouraging according to these figures, as the superphosphate plots yielded less than the check plots in all cases. Manure, in addition to superphosphate, produced larger yields than superphosphate alone, but even this combination did not produce yields noticeably larger than those of the check plots. This condition occurred only with flax, as all other crops grown on the same plots in other years responded more favorably to the superphosphate treatment than to no fertilizer treatment. Manure, when applied alone, resulted in an increase of 4.13 bushels of seed from

Table 1.—Summaries of yields of unthreshed straw, threshed straw, and fiber in pounds per acre, and seed in bushels per acre, obtained from flax plots in 1928, 1930 and 1931 on Ontonagon clay loam soil in Chippewa County.

Treatment	Linota Seed Flax						Saginaw Fiber Flax							
	Unthreshed straw		Threshed straw		Seed		Unthreshed straw		Threshed straw		Seed		Fiber	
	Average of 3	Average of 4	Average of 3	Average of 4	Average of 3	Average of 4	Average of 2	Average of 3	Average of 2	Average of 3	Average of 2	Average of 3	Average of 2	Average of 3
Lime 0-0-0	3927	4222	2057	2285	18 33	18 13	4223	4604	2635	2950	15 36	14 82	584	626
Lime 0-16-0	3330	3587	1836	1998	14 47	14 88	4586	4654	2307	2546	14 53	14 29	538	574
Lime 0-16-0 plus manure	3878	*—	2095	*—	18 20	*—	4593	*—	2960	*—	16 29	*—	651	*—
Lime 0-16-4	4811	4832	2554	2629	21 82	20 44	4250	4574	2748	2974	14 25	13 59	619	620
Lime 4-16-0	4122	4331	2443	2532	21 81	20 73	4437	4815	2836	3138	15 83	14 52	658	701
Lime 2-16-4	4287	4456	2426	2577	20 13	19 69	4741	4998	3094	3313	16 13	15 66	703	751
Lime 4-16-4	4663	5030	2504	2811	21 96	21 58	4512	4931	2903	3291	15 54	15 14	663	684
4-16-4	4289	4782	2349	2718	19 04	19 27	4942	5203	3210	3426	16 34	15 31	752	748
Lime 6-16-4	4743	4723	2664	2715	20 86	19 78	4921	5033	3312	3463	15 63	14 14	786	807
Lime manure	4663	*—	2516	*—	22 46	*—	4865	*—	3083	*—	16 97	*—	702	*—

*In 1928 there were no manure plots As a result there was one less harvest from manure treatments than from other treatments In case of seed flax the column headed (average of 3) is the average of three harvests during the years when manure was used The column headed (average of 4) is the average of four harvests only from plots not manured The case is the same for fiber flax except that there is one less harvest of fiber than of seed flax

seed flax, which was the largest increase obtained over that of the untreated plot. By use of fertilizers, greater increases of seed were obtained from seed flax than from fiber flax.

Lime did not appreciably affect the yields of either seed flax or fiber flax except possibly through its influence on the growth of soil building crops, such as clovers, but the high analysis fertilizers, as 4-16-4 and 6-16-4, resulted in yields consistently higher than those of the check plots, except in one instance. The 4-16-4 fertilizer seemed to show the best results with seed flax on this soil, and it is possibly the best one to use. However, it seems advisable to recommend the use of this fertilizer on crops that respond more favorably to fertilizer treatments and to follow these crops with flax so that it may use the residual fertilizer that was not used by the preceding crop. The additional straw obtained from the seed flax, due to certain fertilizers, might have some slight value if the straw were used for upholstering material; but, at present, there are no unholstering mills located in that region, so the straw has little or no value. The seed yields of the seed flax are exceptionally good as compared with seed yields obtained from flax grown in the north-central western States which constitute the main seed flax section. The greatest difficulty encountered in growing seed flax in Chippewa county is that the climate at harvest time is unfavorable, and the continuous rains or wet weather in the fall may prevent the flax from being harvested before snow falls.

In fiber flax, the fiber yield is most important and the seed production is secondary, so that fertilizers favoring large yields of high quality fiber are desirable. The yields of straw from fiber flax increase with the application of commercial fertilizers, but the maximum increase over the yields from unfertilized plots for the average of three harvests is only 599 pounds of unthreshed straw and 513 pounds of threshed straw. The seed yields from fiber flax were exceptionally good, but the variety of fiber flax that was used was one which yields a very large quantity of seed and only a medium amount of straw and fiber. The seed increase due to fertilizer over the no-treatment plot is not great, and it would not be advisable to apply fertilizer for such a slight increase, especially if there is a possibility of lowering the quality of fiber by the addition of fertilizer. The yields of fiber were higher than are ordinarily obtained where flax is grown commercially but this was partly due to the machine used for scutching the fiber. By use of a machine of the Lowry type, higher yields are secured than those ordinarily obtained with scutching wheels. As shown in Table 1, the fiber yields increased with the addition of fertilizers, especially with such analyses as 2-16-4, 4-16-4, and 6-16-4.

At present there are no fiber flax mills located in Chippewa county; so no fiber flax is grown on a commercial scale. The quality of the fiber from these experiments has been judged below the average of European or Canadian fiber. This is true in spite of the fact that the climate is cool and damp and suited for fiber production. However, this soil is not the best for fiber production, and apparently, has some influence in lowering the fiber quality. The fiber was very strong, coarse, harsh, and lacked spinning quality. Should there ever exist a demand for strong fiber to use for coarse yarn, fiber flax might be profitably grown in Chippewa county.

THE "NEW LOGAN" BLACK RASPBERRY

STANLEY JOHNSTON, SECTION OF HORTICULTURE

For several years, there has been a strong demand from small fruit growers for new black raspberry varieties of merit. This demand for new varieties has been particularly emphasized because the standard varieties now being grown have proved to be susceptible to the virus diseases that have been so destructive during recent years.

Plant breeders, nurserymen, and growers have joined in the search for a new black raspberry variety that would produce fruit equal to that produced by the varieties commonly grown and, at the same time show greater resistance to disease. Of the many black raspberry varieties tested at the South Haven Experiment Station, only one, New Logan, has shown sufficient merit to warrant further testing by commercial growers.

New Logan, although it originated in Illinois, was introduced into Northern Ohio about 17 years ago where it has gradually gained in popularity until it is now extensively grown in that district. It has been grown at the South Haven Experiment Station for five years.

The plant is vigorous and productive. The fruit matures about a week earlier than Cumberland, is somewhat smaller than the latter variety, cans and ships well, and is of excellent quality. Though it cannot be said that the plants are immune to virus diseases, they have shown a remarkable freedom from them.

New Logan is probably a little less productive and will produce berries slightly smaller than Cumberland at its best; but its apparent resistance to virus diseases, fine quality, and early ripening are of sufficient importance to warrant giving it a thorough commercial test.

EXPERIMENTS WITH GROWING CROP MIXTURES

Yields Indicate Plantings of Two Crops Furnish Larger Amounts of Feed in Some Cases

J. W. THAYER, JR., SECTION OF FARM CROPS

Growing two or more crops together, such as oats and peas or oats and barley, for the home feeding of livestock is a common practice in certain sections of the country. Growers have found that crop mixtures, to be of value, must meet certain requirements.

1. The mixture should yield more per acre than the crops when grown alone.
2. The crops in the mixture must ripen at the same time.
3. The rate of seeding should be such that it produces the desired mixture at harvest.

Interest in the growing of such mixtures in Michigan, caused the Michigan State College Station to begin experiments in 1929 to determine whether certain mixtures might be of value to Michigan farmers. Some of the outstanding varieties of Michigan grains and other crops were used in the test. Each variety was planted alone and in different combinations to compare the yields and to obtain information about the desirability of the different mixtures.

Feed mixtures at East Lansing, 1931. Left: Spartan barley and Iogold oats, early maturing varieties. Right: Wisconsin No. 38 barley and Wolverine oats, a later maturing mixture.

During the season of 1930, the test was repeated, but with several changes from that of 1929. Mixtures that did not ripen together or seemed undesirable for other reasons were eliminated, and other mixtures that might prove desirable were added. In several mixtures, the rate of seeding was also changed.

Because of unfavorable conditions, the yields for the first two seasons were not what would normally be expected. The work, however, yielded valuable data concerning the dates of ripening and of the percentages of each variety of seed in the harvested mixtures. The data indicate those mixtures which might be of value for future use.

In 1931, the test with certain changes was carried out on a larger

scale. Three-crop mixtures were added to the test; the rate of seeding was increased in some mixtures previously used; and Wisconsin No. 38 barley, a smooth-awned type having other characteristics similar to the old rough-awned type of Wisconsin No. 9 barley, was substituted for the Wisconsin No. 9 barley in the test.

Table I gives the data of the test as it was conducted this past season. The crops are listed according to the amount of digestible nutrients yielded per acre. Wisconsin No. 38 heads the list with a yield of 2286 pounds of digestible nutrients per acre and the mixture of Wisconsin No. 38 barley with Wolverine oats stands second with a yield of 2150 pounds. An objection to Wisconsin No. 38 barley, which offsets its greater yield, is the weakness of its straw. This variety lodged considerably, indicating that its straw was materially weaker than that of some other varieties, particularly the Spartan. The mixture of Wisconsin No. 38 and Wolverine, however, did not lodge, indicating that the stiffer straw of the oats helped to keep the barley erect.

Table I.

Crop or Mixture	Rate of seeding pounds per acre	Yield pounds per acre	Rank	Per cent of mixture at harvest	*Digestible nutrients pounds per acre	Rank
Wisconsin No. 38 barley	84	2879	1	....	2286	1
Wisconsin No. 38 barley Wolverine oats....	48 32	2805	2	69 5 30 5	2150	2
Spartan barley ... Iogold oats ...	48 32	2584	4	58 1 41 9	1954	3
Iogold oats	64	2705	3	.....	1901	4
Spartan barley...	72	2383	7	....	1802	5
Spartan barley... Markton oats...	48 32	2428	6	59 6 40 4	1830	6
Wisconsin No. 38 barley Wolverine oats........ Marquis wheat...	32 24 45	2384	8	46 3 26 9 26 8	1839	7
Wolverine oats....	64	2442	5	......	1719	8
Spartan barley... Iogold oats...... Canada field peas	32 24 45	2159	10	49 0 38 1 12 9	1631	9
Spartan barley... Canada field peas. ...	48 60	1982	11	82 0 18 0	1563	10
Markton oats.... ...	64	2169	9	...	1527	11
Emmer (Spelts)........	80	1972	12	.....	1509	12
Wolverine oats... ... . Canada field peas.....	32 60	1808	13	92.5 7.5	1281	13
Wolverine oats.... .. .. English field peas........	32 60	1741	14	82 0 18 0	1244	14
Marquis wheat.......	120	1547	16	......	1238	15
Giant Perfection oats...	64	1604	15	....	1129	16
O. A. C. No. 181 field peas... ..	120	1069	17	....	815	17
English field peas.....	120	751	18	... .	572	18
Canada field peas................	120	684	19	....	521	19

*Figured from tables in Henry & Morrison: "Feeds and Feeding."

A comparison, in Table I, of the yield of digestible nutrients with the yield of total pounds produced per acre shows that certain crops, although yielding heavily in pounds per acre, actually produce less feed value than other crops which yield fewer pounds per acre. The comparison of yields, of digestible nutrients from the mixtures, and of their component crop varieties when grown alone brings out the following points: 1. The yield from the mixture of Spartan barley and Iogold oats is greater than that of either of the grains when grown alone; 2. The yield of the other mixtures falls between that of the highest and the lowest yielding component crop of the mixture.

To prove the value of mixtures from a yield standpoint, it is necessary to compare the yield per acre of the mixture with the yield of its component grains when grown alone. Another worker has made this comparison in the following manner. "When oats and barley were grown together they gave a higher yield than was produced on an equal area, half of which was used for pure oats and the other half for pure barley."* Since the present work shows that crops growing in mixture do not usually yield in the same proportion as the same crops when grown alone, the following method of calculation, to determine the yield "Alone," was used:

Wisconsin No. 38 barley } Wolverine oats }	Yield per acre 2805 lbs. Analysis 30.5% oats, 69.5% barley
Wisconsin No. 38 barley	Yield per acre 2879 lbs.
Wolverine oats	Yield per acre 2442 lbs.

$$2805 \times 30.5 = 855.5 \div 2442 = .3503$$
$$2805 \times 69.5 = 1949.5 \div 2879 = .6771$$
$$\overline{1.0274}$$

2805 ÷ 1.0274 = 2730 lbs., the yield from one acre, if the grains were grown alone and mixed after harvest in the same proportions as the above mixture.

Table II compares the yield obtained from the crops grown in mixture with that obtained from the same crops when grown alone. The crops grown in mixture outyielded the crops grown alone in all except one instance. The mixture of Spartan barley and Canada field peas outyielded these crops when grown alone by 16.9% and the mixture of Spartan barley, Iogold oats and Canada field peas outyielded the component crops grown alone by 13.4%. The mixture of Wolverine oats and Canada field peas yielded 11.6% less than these two crops growing alone. These results indicate that it is comparatively easy to grow a mixture of crops that will outyield the same crops grown alone.

The problem of obtaining crops which will ripen at the same time when grown together is not a difficult one. In some cases, however, there was a decided tendency for crops grown in mixture to ripen later than the same crops when grown alone. In the tests of 1931, the crops within each mixture ripened at approximately the same time and produced in all cases a good quality of feed mixture.

*Forty Years Experiments with Crops. C. A. Zavitz, Ont. Dept. Agri. Bul. 332, p. 40, 1927.

Table II.

Mixture	Yield in pounds per acre		Digestible nutrients pounds per acre		Per cent of increase Together over Alone
	Alone	Together	Alone	Together	
Wisconsin No. 38 barley Wolverine oats	2730	2805	2092	2150	2 7
Spartan barley Iogold oats	2508	2584	1896	1954	2.9
Spartan barley Markton oats	2292	2428	1736	1839	5 6
Wisconsin No. 38 barley Wolverine oats Marquis wheat	2251	2384	1736	1839	5.6
Spartan barley Iogold oats Canada field peas	1869	2159	1412	1631	13 4
Spartan barley Canada field peas	1647	1982	1299	1563	16 9
Canada field peas Wolverine oats Canada field peas	2047	1808	1450	1281	—11 6
Wolverine oats English field peas	1738	1741	1242	1244	0 2

One aim of the experiment was to determine whether it is possible to regulate the percentage of each crop in the feed mixture by the rate of seeding. As may be noted in Table I, the rate of seeding for the oat and barley mixtures was kept constant, but the percentage of mixture in the harvested crop varied greatly. Similar results may be noted for the other mixtures. The results of the two previous seasons' work showed similar variations. The data do not prove that these variations are due to the differences in the ability of varieties to compete against each other when grown in mixture, but they tend to show that such may be the case.

Probably the most important factor influencing the percentage of each crop in the material harvested from a mixture is the environmental conditions under which the crop is grown. As there are more barley and oat combinations than other mixtures in the tests, only data from them are taken to show the effect of seasonal and soil conditions on the percentage of mixture in the harvested crop. The average percentage of oats and barley, with the number of combinations, for the past three seasons is as follows:

1929	5 combinations	oats 87%	barley 13%
1930	3 combinations	oats 65%	barley 35%
1931	3 combinations	oats 35%	barley 65%

The data indicate that the conditions under which the crops were grown in 1929 and 1930 greatly favored the production of oats, whereas those of 1931 favored the growing of barley.

The results of this experiment make evident certain advantages and disadvantages in the growing of crops together for feed mixtures. The advantages are as follows:

1. Crops which will ripen together and produce a feed mixture of good quality may readily be grown in mixture.
2. In many cases, the yields per acre are likely to be greater where crops are grown together than where the same crops are grown alone.
3. Since seasonal conditions greatly favor the production of different crops from year to year, the grower by planting a mixture would always be taking partial advantage of the seasonal conditions.

To offset these advantages one should consider that:

1. It is impossible, in the average season, to predetermine, within narrow limits, the percentage of mixture at harvest time by the rate of seeding. Therefore, to be sure of having the desired mixture for feeding, it will be necessary to analyze the mixture at harvest and if necessary mix it with other crops.
2. A mixture of crops, unless easily separable, will bring a low price if it is necessary to dispose of it on the open market. Any grower likely to produce a surplus of such feed crops will find it advisable to grow them separately in pure condition.

Considering the small increases obtained, as shown by these tests, from growing crops in mixture and the apparent disadvantages of this practice, it is advisable to await further experimental data under Michigan conditions before adopting the practice on any large scale.

THE GRAPE-BERRY MOTH IN 1932

This Insect is Serious Enemy of Michigan Grapes.

R. H. PETTIT, SECTION OF ENTOMOLOGY

Aside from local injury by the rose-chafer and, on occasional years, attacks by leaf-hoppers and climbing cutworms, the most destructive insect depredations on grapes in Michigan are made by the grape-berry moth. This insect, which develops two, and sometimes a partial third, generation each year, passes the winter enveloped in a small cocoon which is enclosed in a folded flap cut from a leaf. Such flap-enclosed cocoons drop out, fall to the ground, and are, therefore, pretty well protected during the winter season by a covering of trash and some of the time by a blanket of snow. Just before blossoming-time, a tiny moth, or "miller," emerges from each of the cocoons and lays its quota of eggs among the buds. Shortly after this, the eggs hatch and produce larvae, or "worms," that spin webs quite freely in the tiny forming cluster, and they continue to do so for some little time after full bloom. These larvae feed on the buds, blossoms, and small sets; each larva devours a number of sets and then cuts a little flap in a leaf, folds

it over, and spins a cocoon in the enclosure. Later, the larva changes to a pupa and produces, shortly afterward, a tiny moth like its parent. During the growth of the second generation, the same program is repeated except that, as the grapes are larger at that time, not so many of them are required to feed each larva. During the second and third generations, there is considerable wandering from one berry to another, accompanied by the spinning of silken webs.

The first work of the grape-berry moth is, therefore, apparent about blossoming-time, often followed by a period during which the work of the larvae is not very much in evidence. The second generation sometimes builds up to a point where the injury begins to be serious, but it is during seasons where the third generation is developed to epidemic

Fig. 1.—Blossom cluster showing webbing of first-brood larva of grape-berry moth.

proportions that the serious, destructive attacks occur. There occasionally comes a season when, due to hot weather and a late fall, the third generation builds up to a size that enables it to become very destructive during the last end of the growing period.

In the past, growers have depended almost altogether on arsenical sprays to keep the grape-berry moth in check. Heavy sprays have been applied just before and after blossoming-time, followed by several sprays at 10 days or two weeks intervals, and continued up to the time the grapes touch in the clusters. At this time it becomes impossible to force the spray in between the berries. In some localities, even as ambitious a program as that outlined has failed to give satisfactory commercial control. Furthermore, at the present time, growers are confronted with the necessity of producing grapes free enough from

residue to come within the tolerance allowed by the federal and state pure-food authorities. Grapes can be successfully washed, to be sure, but any extra handling of grapes results in injury to the fruit and a reduction in their value. The main difficulty in commercially washing grapes is encountered in the drying process. To be sure, it is not impossible that better machinery may be developed which will wash and dry grapes in a satisfactory manner. Nevertheless, grape growers in general will agree that if it is possible to control the grape-berry moth in such a way that the grapes will not require washing, it should be done.

Certain conditions favorable to the welfare of the grape-berry moth are known to exist. During the winter-time, a heavy blanket of snow serves as a protection for the cocoons on the ground. Such parts of the vineyard as are covered by deep snow should be watched carefully and perhaps given especial attention. Such parts of the vineyard as are in close proximity to woodlots or to growth of brush and scrub trees are very likely to have more than their fair quota of moths. Perhaps this is because the trees cause wind-breaks and cause the snow to drift in their vicinity. The presence of leaves and grass or weeds in the vineyard is to be avoided as far as is practicable.

Fig. 2.—Cocoons of grape-berry moth on leaf, somewhat reduced.

The vineyards should be plowed at the first opportunity in the spring, in order to cover up the flap-enclosed pupae and larvae that are resting on the ground. Early plowing permits the soil to settle and become compacted, thus preventing the emergence of the moths in large degree. The plowing back of this soil should be delayed as well, until the buried insects are surely dead. Where a cover crop is employed, the early planting of such plants will allow the crop to get the major part of its growth in the fall, thus making it practical to plow early the following spring.

Spraying

Bearing in mind the fact that the federal food administration has already announced that during the season of 1932 the world's tolerance in relation to residue on all fruits in America will go into effect, and that methods of washing grapes with chemicals have not as yet been developed to a high degree of efficiency, it would seem the part of wisdom to avoid the application of heavy arsenical sprays during the latter part of the growing season, and to concentrate the applications during the early part. It would appear that a heavy arsenical spray should be applied just before bloom, and that this should be followed

Fig. 3.—Injury to grapes by second-brood larvae of grape-berry moth.

by another heavy arsenical spray 10 days afterward, followed by one more at the time when the grapes reach a diameter of one-quarter inch, after which time it is believed that the danger from the accumulation of residues is greater.

Special care should be given to areas that have been protected by deep snow during the preceding winter and to areas, bordering on scrub growths and wood-lots, where leaves have accumulated during the winter. In the meantime, the Entomology Department is always searching for some spraying material that may be used with safety late in the season, or one that will not remain on the fruit in the form of a prohibitive residue.

SOIL PREPARATION AND FERTILIZERS FOR TOMATOES

Commercial Fertilizers Increase the Yield and Hasten Maturity of Fruit

R. L. COOK, SECTION OF SOILS

Tomatoes are grown on a commercial scale in many localities throughout southern Michigan. In some sections they are grown largely for canning purposes, while around the large centers of population they are produced for sale as fresh fruit on the local markets. In addition to the prominence of this crop in the commercial gardening enterprise, it is very commonly found in the home garden.

Whether grown on a commercial basis or in the home garden, the producer is interested in getting as large yields as possible and in inducing the fruit to mature early. The price of tomatoes is usually high when the crop first stars to ripen, after which time it drops rapidly. This situation means greatly increased profits for the farmer who can market a considerable portion of his crop before the bulk of the tomatoes in his locality are mature.

The object of this article is to discuss briefly methods of handling the soil to bring about large yields of early maturing fruit.

Soils Suitable for Tomatoes

Tomatoes can be grown with reasonable success on a great variety of soils. The market for which they are being grown should influence the farmer in selecting his soil. If tomatoes are produced for the local market, a sandy soil is best because on such soils, due to a less vigorous growth of the plants, the fruit will mature a little earlier than it will on a heavy soil. If the crop is being grown for a canning factory, where the price is fixed for the season, a heavier soil is more suitable because larger yields are usually obtained.

Preparing the Soil

For maximum yields of tomatoes, it is necessary to have plenty of organic matter in the soil. The rotation should include some legume such as alfalfa, clover, or sweet clover; and, wherever possible, stable manure should be plowed under in preparation for the tomato crop. Fall plowing is advisable particularly if the soil is heavy. If left until spring, the plowing should be done early. This will provide sufficient time for the killing of weeds by thorough harrowing before the plants are set and will allow time for the soil to become settled. Early plowing will also stop the growth of legumes, grass, or weeds and will thus prevent the loss of a large amount of water through transpiration.

Fertilizers Are a Necessity

As with other crops, it is impossible to obtain best results with tomatoes without the use of ample plant food. It is apparent that larger yields accompany lower production costs; and, when tomatoes are sold as fresh fruit, the earlier maturity resulting from correct fertilization results in higher prices per unit. In order to find out what analyses fertilizers are best and how much can be profitably applied on different soils, the experiments reported in the following pages were made.

Plan of the Experiment

In 1928, 1929, and 1930, tomatoes were included in the rotation on the soils experimental field located on Berrien sand on the farm of Floyd Judson in Lenawee county. The fertilizer treatments, as indicated in Table 1, included varying quantities of fertilizer as well as different analyses. Every third plat throughout the field was a check plat, that is, it received no fertilizer. Each plat was 25 by 100 feet in size and contained 150 plants. The fertilizer was broadcast by hand and thoroughly worked into the soil by means of a spring tooth harrow a few days before setting the plants. The plants, the Stone variety were furnished by the Acme Preserve Co., of Adrian, Michigan.

The tomatoes were picked and carefully weighed as often as ripening conditions made it necessary. Yields per acre were calculated for each picking.

Another experiment was conducted in 1929 and 1930, on a Napanee loam soil on the farm of Felix Witt of Lenawee county. The plan of this experiment was similar to the one just described except that each treatment was repeated on a second series of plats and a check or unfertilized strip ran between the two rows of plats. On this field, the variety was Spark's Earliana.

Very little disease was noticed on the plats; and, because of the care exercised in setting and resetting the plants, almost a perfect stand of plants was obtained. Because of the rather large size of the plats, no correction was made in the yields on those plats where one or two plants were missing.

Description of Soil Types

The Berrien sand is a level to slightly rolling soil with a grayish brown loamy sand surface to a depth of six or eight inches. Below that is a layer of yellowish loosely coherent sand extending to a depth of about 20 inches. A mottled yellowish sand then extends to a depth of three to five feet where a layer containing enough clay to retain water fairly well is encountered.

The Napanee clay loam in the cultivated state has a grayish brown silty clay loam surface soil extending to a depth of about eight inches. Below this is a three or four inch layer of light gray ashy material underlain by a 15 to 20 inch layer of heavy plastic clay mottled with gray and yellowish brown. Below at a depth of about 30 inches is found a very heavy, plastic, calcareous clay mottled with gray and light yellowish brown. This last layer is almost impervious to water, making artificial drainage necessary in many cases. This soil is slightly acid on the surface and is alkaline below the first two layers. It is naturally very fertile.

Experimental Results

The total yields presented in Tables 1, 2, and 3 show conclusively that it is impossible to grow tomatoes profitably on this field of Berrien sand without the use of commercial fertilizer. Figure 1 shows a typical result of an attempt to produce tomatoes without fertilizer in contrast with the growth when fertilizer is applied. The data in Table 1 show that in 1928 a considerable profit was obtained by the application of superphosphate alone but that greatly increased profits resulted from the addition of either nitrogen or patosh to the fertilizer. The greatest profit came from the plat receiving 1,000 pounds of 4-16-8 fertilizer.

Fif. 1.—Fertilizer will greatly increase the growth of tomatoes. Right, 500 pounds of 0-16-8 applied broadcast. Left, no fertilizer.

The year 1929 was rather dry compared to 1928 so one would expect somewhat different results from fertilizers. The data in Table 2 show this to be true. Although there are large increases in profit from the use of fertilizer and the figures show the complete fertilizer to be necessary, it is apparent that 1,000 pounds was too much. The greatest profit was obtained from the 500 pound application of 4-16-8.

The year 1930 was very dry and the plants on all the plats grew very slowly and were late in reaching maturity. This is apparent from the large percentages of the fruit not mature at the last picking. The profits due to fertilizer, as would be expected in such a year, were small as compared to those in other years. There was some profit, however, on all but two of the plats. The greatest profit was again from the plat receiving 1,000 pounds of 4-16-8 but it was only slightly higher than that obtained from the plat to which 500 pounds was applied.

Table 1.—The effect of fertilizers on the yield and date of maturity of tomatoes grown on Berrien sand. 1928.

Treatment		Total yield per acre pounds	Per cent mature September 3	Per cent not mature October 2	Value of marketable fruit	Increase in value due to *fertilizer	Cost of fertilizer	Profit due to fertilizer
0-16-0	250	7228	3 00	31 25	$24 84	$5 80	$3 30	$2 50
	Check	7239	.74	47 37	19 04			
0-16-4	250	10817	4 18	16 86	44 96	27.13	3 87	23 26
0-16-8	250	14002	3 26	21 77	54 76	38 16	4.45	33.71
	Check	5803	46	46 92	15 40			
2-16-8	250	11426	6 95	11 91	50 32	27 08	5 39	21 69
4-16-8	250	12003	5 75	11 33	53 21	22 13	6 32	15.81
	Check	10889	2 08	28 50	38 92			
0-16-0	500	16337	4 60	8 99	74 33	40 20	6 60	33.60
0-16-4	500	17215	5 71	7 75	79 40	52.05	7.74	44 31
	Check	6663	6 19	32 28	22 56			
0-16-8	500	14896	4 93	9 51	67 40	42 39	8 90	33.49
0-16-16	500	16353	5 05	6 98	76 05	49.59	11.20	38 39
	Check	9522	0	37.16	29 91			
2-16-8	500	15788	4.61	8.79	72 00	46 53	10 78	36.75
4-16-8	500	18014	4 74	10.88	80 27	59.23	12.64	46.59
	Check	6696	4 22	50 42	16 60			
0-16-0	1000	12368	3 78	18 70	50 27	34 35	13.20	21.15
0-16-4	1000	17173	9 06	4 12	82 32	67 08	15 48	51 60
	Check	5090	0	42 78	14 56			
0-16-8	1000	21215	3.92	10 52	94 91	82 29	17.80	64.49
2-16-8	1000	24811	5 57	13 60	107 17	96.50	21.56	74.94
	Check	5313	0	67 12	8 73			
4-16-8	1000	30756	4 72	11.68	135.81	127.08	25.28	101 80

*In all the calculations tomatoes are considered to be worth $10.00 per ton. The cost of the fertilizer is calculated on the basis of $3.75 per unit for nitrogen, 90 cents per unit for phosphoric acid, $1.15 per unit for potash, and $12.00 per ton overhead cost. Profit is taken as being the value of the increase in yield minus the cost of the fertilizer. Loss is the cost of the fertilizer minus the value of the increase in yield, or the value of the decrease in yield plus the cost of the fertilizer.

Table 2.—The effect of fertilizers on the yield and date of maturity of tomatoes grown on Berrien sand. 1929.

Treatment		Total yield per acre pounds	Per cent mature September 2	Per cent not mature October 8	Value of marketable fruit	Increase in value due to fertilizer	Cost of fertilizer	Profit due to fertilizer
0-16-0	250	8765	3 50	24 8	$32 95	$20 60	$3 30	$17 30
	Check	4511	2 92	45 3	12 35			
0-16-4	250	8460	4 10	21 2	33 31	22 91	3 87	19 04
0-16-8	250	10711	3 28	21 3	42 15	35 71	4 45	31 26
	Check	3204	0	59 4	6 49			
4-16-4	250	9924	3 98	24 2	37 61	32 13	5 75	27 38
4-16-8	250	10801	40	26 7	39 55	35 08	6 32	28.76
	Check	1873	0	62 8	3 46			
0-16-0	500	6806	97	27 0	24 83	20 84	6 60	14 24
0-16-4	500	9367	47	26 7	34 33	29 80	7 74	22 06
	Check	2438	0	58 4	5 06			
0-16-8	500	11057	2 38	22 6	47 78	43 22	8 90	34 32
0-16-16	500	12776	1 23	19 1	51 73	47 68	11 20	36 48
	Check	2461	0	71 1	3 55			
4-16-4	500	15110	2 90	16 2	63 30	60 58	11 50	49 08
4-16-8	500	16216	2 99	18 4	66 18	64 30	12 64	51 66
	Check	1086	0	80 6	1 05			
0-16-0	1000	8189	81	34 8	26 69	17 67	13 20	4 47
0-16-4	1000	15854	1 67	21 6	62 17	45 39	15 48	29 91
	Check	9260	48	46 7	24 65			
4-16-4	1000	14586	5 2	16 3	61 00	41 71	23 00	18 71
4-16-8	1000	14824	2 67	8 6	67 77	53 85	25 28	28 57
	Check	4186	53	63 8	7 56			
0-16-0	500	11522	2 29	19 9	46 11	39 55	6 60	32 95

Table 3.—The effect of fertilizers on the yield and date of maturity of tomatoes grown on Berrien sand. 1930.

Treatment		Total yield per acre pounds	Per cent mature September 3	Per cent not mature October 11	Value of marketable fruit	Increase in value due to fertilizer	Cost of fertilizer	Profit due to fertilizer
0-16-0	250	14671	5 68	59 09	$30 00	$17 93	$3 30	$14 63
	Check	10676	2 38	77 38	12 07			
0-16-4	250	10540	4 67	56 45	24 95	12 54	3 87	8 67
0-16-8	250	13039	3 91	59 97	26 09	12 75	4 45	8 30
	Check	11458	1 34	77 15	13 09			
4-16-4	250	15283	2 00	59.62	30 85	20 28	5 75	14 53
4- 8-6	250	11475	1 92	74 96	14 36	6 32	5 14	1 18
	Check	7565	1 34	85 39	5 52			
0-16-0	500	11526	1 91	77 28	13 09	4 23	6 60	None
0-16-4	500	13311	1 53	75 34	16 40	4 19	7 74	None
	Check	12563	54	75 23	15 55			
0-16-8	500	17119	2 09	58 53	34 59	21 34	8 90	12 44
0-16-16	500	15861	2 14	56 80	34 25	24 49	11 20	13 29
	Check	9503	36	82 28	8 41			
4-16-4	500	28390	1 55	69 46	43 35	35 41	11.50	23.91
4-16-8	500	26350	1 35	67 74	47 50	40 23	12 64	27.59
	Check							
0-16-0	1000	14178	2 03	56 80	30 60	24 37	13 20	11.17
0-16-4	1000	15249	1 56	48 16	39 52	33 86	15 48	18 38
	Check	6103	83	83 56	5 01			
4-16-4	1000	25483	2.60	59 10	52 10	47 81	23 00	24.81
4-16-8	1000	24786	2 60	53 08	58 14	54 77	25 28	29.49
	Check	4862	0	89 51	2 55			
0-16-0	500	13906	1 95	71 39	19 89	17 35	6 60	10 75

From these three years results, it is apparent that at least 500 pounds of 4-16-8 fertilizer is to be recommended for tomatoes grown on this soil, and in normal years larger applications will prove more profitable.

When tomatoes are grown on a heavy soil which is naturally much more fertile than a sandy soil, there is likely to be less profit obtained from the use of commercial fertilizer. An examination of the data presented in Table 4 shows the truth of this statement. Although three of the plats show a loss due to the fertilizer application it is apparent that on those plats which received the proper fertilizer a good profit was obtained. Nitrogen apparently was not needed on this field, the most profit having come from those plats receiving phosphoric acid and

Fig. 2.—Fertilizer will hasten maturity. **Left Pile**—Ripe tomatoes on a plat where the fertilizer was applied broadcast—second picking. **Right pile**—Ripe tomatoes on a plat where the fertilizer was applied around the hill—second picking.

potash. Where 0-16-0 was applied at the rate of 500 pounds per acre, one plat showed a loss of $7.32 and the other a profit of $4.18. When 8 per cent of potash was used along with the phosphoric acid, the profit was raised to $14.34 and another 8 per cent of potash, making an 0-16-16, produced the greatest profit of all, $31.50 per acre. One thousand pounds of 0-16-0 gave better results than 500 pounds but was still not as profitable as 500 pounds of 0-16-16.

During 1930, the experiment was conducted on a field which was very fertile because it had been used as a hog pasture previous to that year. The extremely high yields are proof of this condition. Considering this and the dry weather of that year, it is not surprising that the fertilizer gave no significant increases in yield.

Table 4.—The effect of fertilizers on the yield and date of maturity of tomatoes grown on Napanee soil. 1929.

Treatment		Total yield per acre	Per cent mature August 24	Per cent mature September 4	Per cent not mature October 3	Value of marketable fruit	Increase in value due to fertilizer	Cost of fertilizer	Profit due to fertilizer	Loss due to cost of fertilizer
0-16-0	500	5588	0	21 90	9 48	$25 29	None	$6 60		$7 32
	None	7256	0	13 20	28 30	26 01				
4- 8-4	500	8767	0	16 70	19 40	36 51	12 21	9 70	$2 51	
	None	7086	0	11 50	31 40	24 30				
4-12-4	500	10020	0	16 18	16 25	41 96	24 22	10 60	13 62	
	None	6585	0	3 80	44 60	17 74				
4-16-4	500	6971	0	15 57	26 05	25 77	4 31	11 50		7 19
	None	6436	0	6 50	33 30	21 46				
0-16-0	500	6996	0	10 20	28 75	24 92	10 78	6 60	4 18	
	None	5403	0	3 05	47 65	14 14				
4-16-8		10115	0	7 80	35 45	32 64	12 00	12 40		40
	None	6916	0	5 60	40 30	20 64				
0-16-8	500	12990	0	7 80	29 60	45 72	23 24	8 90	14 34	
	None	7738	0	3 70	41 90	22 48				
0-16-16	500	16114	0	6 33	19 10	65 18	42 70	11 20	31 50	
	None	7738	0	3 70	41 90	22 48				
4-16-16	500	15983	0	7 57	24 40	60 41	36 84	14 95	21 89	
	None	7896	0	5 60	40 30	23 57				
4-16-4	1000	13161	0 49	6 34	29 60	51 27	37 13	23 00	14 13	
	None	5403	0	3 05	47 65	14 14				
0-16-0	1000	13778	0	10 62	19 35	55 56	34 10	13 20	20 90	
	None	6436	0	6 50	33 30	21 46				
0-16-16	1000	15120	49	14 25	21 30	57 50	35 35	22 40	12 95	
	None	6585	0	7 4	32 40	22 15				
3-14-6	500	13266	1.29	12 72	20 65	52 63	24 87	10 69	14 18	
	None	7136	0	15 40	22 29	27 76				
6-24-12	500	11067	2 60	15 75	20 30	44 10	15 41	19 97		4 56
	None	7256	0	15 50	20 90	28 69				

Table 5.—The effect of fertilizers on the yield and date of maturity of tomatoes grown on Napanee soil. 1930.

Treatment		Total yield per acre pounds	Per cent mature August 18	Per cent not mature October 10	Value of marketable fruit	Increase in value due to fertilizer	Cost of fertilizer	Profit due to fertilizer	Loss due to fertilizer
0-16-0	500	38,425	1 89	41 47	112 45	None	6 60		17 99
	Check	41,873	1 40	40 85	123 84				
0-16-8	500	47,224	3 00	39 12	143 75	8 72	8 90		18
0-16-16	500	47,806	2 58	38 61	146 74	50	11 20		11 70
	Check	46,707	1 01	32 59	157 43				
4-16-16	500	53,447	1 61	34 26	175 68	18 15	14.95	3 20	
4-16-8	500	45,098	2 52	34 37	147 99	None	12 40		23 16
	Check	44,772	1 42	29 53	157 75				
4-16-8	1000	50,407	2 34	34 50	165 08	12 23	24 80		12 57
6-28-12	250	49,867	2 47	33 69	165 33	17 40	9 19	8 21	
	Check	44,449	1 39	35 64	143 03				
3-14-6	500	56,553	2 05	35 51	182 35	33 93	10 69	23 24	
	Check	46,951	1 50	34 48	153 81				

The Effect of Fertilizers on the Date of Maturity

In the above discussion, it has been assumed that ripe tomatoes have the same value regardless of the time of maturity. They were sold, under contract, to a canning factory; and, as a consequence, the price was the same throughout the season. If the fruit had been sold on the local market, the profits from the fertilized plats on both fields would have been much higher than those from plats not fertilized. This is because the fruit ripened much earlier on plats receiving fertilizer. An examination of Tables 1, 2, and 3, will show that, with the exception of only two plats in one year, a greater percentage of the fruit was mature on the treated plats than on the untreated plats at the first picking. A further proof of this is found in the column giving the percentages of the total yields which were not mature at the last picking. Except for one plat in 1930, there were larger percentages of green fruit on the check than on the treated plats. During 1929, the 4-16-8 plat had 2.99 per cent of the fruit ripe on September 2, with only 18.4 per cent not mature on October 8. The no-treatment plat beside it produced no mature fruit on September 2, and over 80 per cent of its fruit never ripened. The results on the other complete fertilizer plats in the same and other years were similar.

On the heavy soil, there were four plats which, as shown in Table 4, produced mature fruit as early as August 24. These were all fertilized plats. By September 4, all fertilizer plats except one had matured a higher percentage of their fruits than had the check plats beside them. In 1930, as indicated in Table 5, in spite of the fact that total yields are not in favor of fertilizer, the records show that on all fertilized plats maturity was earlier than on the no-treatment plats. The data in Table 5 have been calculated on the basis that fertilizer may have caused decreases in yields, and in that case a loss due to fertilizer is indicated. Because of the fact that some plats produced a profit and some a loss and because the loss in most cases was due to the cost of the fertilizer and not to decreased yields, it seems justifiable to conclude that the fertilizer had no effect at all on the total yields for the season. Turn now to Table 6 where the yields for only the first picking are considered. At that time, August 18, the fruit was actually worth on the local market, five cents per pound. The increases in yield due to fertilizer, calculated by interpolating between the checks, are large enough at that price to pay for all the fertilizer and leave a profit on all the plats. The plat treated with 500 pounds of 0-16-8 produced the largest yields at the first picking, making a profit of $34.45 per acre after the cost of the fertilizer was deducted. Considering the total yields in 1929 and the rate of maturity during both 1929 and 1930, it would seem logical to recommend a treatment of 500 pounds of 0-16-8 for tomatoes on this soil.

This tendency for fertilizer to hasten the maturity of tomatoes has been shown by various other workers. Rosa[1] of Missouri found that mixed fertilizers and superphosphate caused plants to reach quantity production four weeks earlier than did the unfertilzed plants. Hepler and Kraybill[2] of New Hampshire have shown that superphosphate greatly increased the proportion of the total crop which matured early

[1]Rosa, J. T.—Missouri Sta. Bul. 169, 1920.
[2]Helper, J. R. and Kraybill, H. R.—New Hampshire Sta. Tech. Bul. 28, 1925.

Table 6.—The effect of fertilizer on the yield of tomatoes on Napanee soil at the first picking. 1930.

Treatment		August 18 lbs. per acre	Increase in yield due to fertilizer first picking lbs.	Value of increase first picking	Cost of fertilizer	Profit due to fertilizer
0-16-0	500	726	136	$6 80	$6 60	$0 20
	Check	590				
0-16-8	500	1418	867	43 35	8 90	34 45
0-16-16	500	1234	723	36 15	11 20	25 95
	Check	472				
4-16-16	500	862	335	16 75	14 95	1 80
4-16-8	500	1135	554	27 70	12 40	15 30
	Check	636				
4-16-8	1000	1180	553	27 65	24 80	2 85
6-28-12	250	1235	609	30 45	9 19	21 26
	Check	617				
3-14-6	500	1158	502	25 10	10 69	14 41
	Check	704				

in the season. At the August price of five cents a pound, a plat treated with 1,000 pounds of superphosphate produced $156.10 worth of fruit per acre during that month. The plat receiving no superphosphate produced only $25.35 worth of fruit during the same period. Similar results were obtained by Lloyd[3] of Illinois.

Location of the Fertilizer

In most localities where tomatoes are grown commercially, it has been customary to broadcast the fertilizer before setting the plants. Experimental results have shown that where the fruit is raised under contract for canning purposes this is a fairly good method, provided the plants are set sufficiently early so the crop will be largely matured before a frost in the fall.

In localities where the crop is raised primarily for sale on the local market, at least a part of the fertilizer should be applied in a different manner. The data presented in Table 7 show that where part of the fertilizer was applied in an 18 inch circle around the hill 5.22 per cent of the fruit was ripe on September 2, as compared to 2.67 per cent on the plat receiving all the fertilizer broadcast. Similar results were obtained from the next two pickings; and, on the last picking, after a

Table 7.—The effect of location of fertilizer on the date of maturity of the fruit. Berrien sand. 1929.

Treatment	Per cent of the total yield of fruit mature at each picking								
	Sept. 2	Sept. 4	Sept. 9	Sept. 12	Sept. 19	Sept. 25	Sept. 30	Oct. 4	Oct. 8
4-16-8 1000 lbs. broadcast	2.67	5 32	16 9	8 86	8 38	15 93	17.85	15 6	8.6
4-16-8 750 lbs. broadcast. 250 lbs. around hill	5 22	7.85	18 6	4.18	14 15	10 3	13 35	19 5	6 6

[3]Lloyd, J. W.—Illinois Sta. Bul. 319, 1929.

hard frost, there was a smaller percentage of immature fruit on the plat receiving fertilizer around the hill than on the plat which had all its fertilizer broadcast. The hill treatments were made right after the plants were set and the fertilizer was thoroughly hoed in.

Table 8.—The effect of location of fertilizer on the date of maturity of the fruit, Napanee loam. 1929.

Treatment			The per cent of the total yield of fruit mature at each picking					
			Aug. 24	Sept. 4	Sept. 12	Sept. 20	Sept. 25	Oct. 3
3-14-6	500	In 6 inch circle 3 inches deep, mixed with soil	6 3	34 4	14 6	16 6	14 8	13 2
3-14-6	500	broadcast ...	3 7	21 8	22 6	17 3	16 0	18 8
6-28-12	250	In 6 inch circle 3 inches deep, mixed with soil ...	7 4	27 0	28 1	20 4	9 8	7 2
3-14-6	500	In 18 inch circle 3 inches deep, mixed with soil ..	2 7	21 2	26 3	15 6	15 5	18 6
3-14-6	500	broadcast..	1 0	8 5	32 0	20 2	18 4	19 9
3 14 6	500	In 18 inch circle on surface. ...	2 2	14 5	23 6	24 4	17 7	17 5

The results presented in Table 8 show the effect of hill application of fertilizer on the date of maturity of tomatoes grown on the heavy soil. At both the first and second pickings, all four plats receiving fertilizer around the hill had matured a higher percentage of their fruits than had the two broadcast plats. On the first plat, when the fertilizer was applied in a six inch circle around the plants, 6.3 per cent of the fruit was picked on August 24 and 34.4 per cent on September 4. The broadcast plat beside it had matured only 3.7 per cent of its total crop by August 24 and only 21.8 per cent was picked on September 4. On the fourth plat, like the first except that the fertilizer was put in an 18 inch circle, 2.7 per cent of the fruit ripened by August 24 and 21.2 per cent by September 4. The broadcast plat beside it had matured 1.0 per cent and 8.5 per cent respectively of its total fruit on those dates. At the last picking, on October 3, there was more immature fruit on the broadcast than on the hill application plats. The two piles of tomatoes shown in figure 2 are those picked on broadcast and hill treated plats on September 4.

Fertilizer in a six inch circle around the hill seemed to mature the fruit faster than when it was spread out in an 18 inch circle.

Summary

Over a three year period, the results obtained on Berrien sand show that not less than 500 pounds of 4-16-8 is to be recommended on this soil. In favorable years, larger applications would be profitable.

The results from experiments on the heavy soil in 1929 show that only phosphoric acid and potash were needed which would lead to a recommendation of 500 pounds of 0-16-8, possibly 0-16-16. In 1930, the total yields obtained gave no indications of the need for any fertilizer. This can be explained by the high state of fertility of the field and the extremely dry season.

With both the Berrien and Napanee soils, every experiment, including the one in 1930 on Napanee soil, points conclusively to the fact that fertilizers greatly hasten the maturity of the fruit. This increases profits by making it possible to market the fruit while the price is high. It also lessens the amount of fruit left on the vines at the end of the season.

Experiments on the location of the fertilizer indicate that, although the total yield is not significantly increased by hill applications, the maturity of the fruit is greatly hastened.

CORN EARWORM, *HELIOTHIS OBSOLETA* AS A GREENHOUSE PEST

Insect Appeared in Unusual Numbers in Commercial Plantings of Ornamentals

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Owners of greenhouses in practically all parts of Michigan suffered unusual losses from the corn earworm and its allies during the season just passed. The "millers," winged moths, which are the adults of corn earworms, were far more plentiful than usual out-of-doors during the latter part of August and early September. Many of these moths entered greenhouses and deposited eggs, singly and indiscriminately, on growing crops, sometimes as many as 3,000 being laid by a single female. This provided for the enormous population of caterpillars which followed.

The first complaints of injury were received about the middle of September when the larvae began to attack the flowers and opening buds of succulent plants. The most serious losses were suffered in houses devoted to growing roses, geraniums, calendulas, and chrysanthemums. On roses, buds were attacked before they opened, the damage being done while the buds were still green. On geraniums, cuttings seemed to suffer the most injury; here the larvae attacked as borers, often starting at the growing tip and eating their way down the succulent stems to the ground. On calendulas, the larvae usually satisfied themselves by feeding on the foliage, though in some instances they tunneled inside the stem. On chrysanthemums, the buds, foliage, and open flowers were attacked.

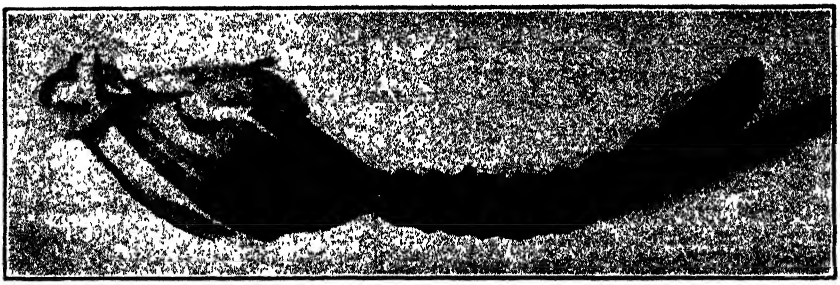


Fig. 1.—Larvae of corn ear-worm on rose bud. Somewhat enlarged.

In chrysanthemum houses, after the buds opened, it was difficult to detect the larvae before they ruined the blossom. The caterpillars crawled down into the center of the flower and severed the petals at their bases. Loose petals on the soil about the plant invariably led to the discovery of a larva hidden in the flower. If unmolested, the larva remained within the flower as long as it retained any food value; when the food supply was exhausted, the larva fed on the leaves until it was able to discover another flower. It is interesting to note that at all times the larvae were to be found on the plants rather than in the soil about the plants. A careful search in the soil made during the middle of the day in houses where there was a high commercial loss failed to disclose any larvae in the soil. This, together with the fact that poison bran bait spread on the surface of the soil failed to reduce the number of caterpillars, leads us to believe that they remained on the plants until they reached maturity.

Besides the injury caused by the corn earworm, some houses were also invaded by the fall army-worm. The work of the two species was so similar in character that no difference could be seen between the damage done by the two insects.

Fig. 2.—Corn ear-worm, work of small larvae in chrysanthemum buds.

The corn earworm is an old offender which has been with us for many years. The damage it causes to staple field crops in the United States is variously estimated at from $18,000,000 to $103,660,000 annually. The species is widely distributed throughout the world between the parallels of 50° north latitude and 50° south latitude. It occurs in destructive numbers in southern Canada, the United States, Central America, and in South America as far south as Argentina. It is also unfavorably known in Europe, Asia, Africa, and Australia because of its destructive habits. In America, it is variously known as "corn earworm," "tobacco budworm." "cotton bollworn," and "tomato fruitworm." It feeds on a number of common weeds, sunflower, ground cherry, hemp, and many of the fruits, as well as various field crops and nearly all the common garden vegetables.

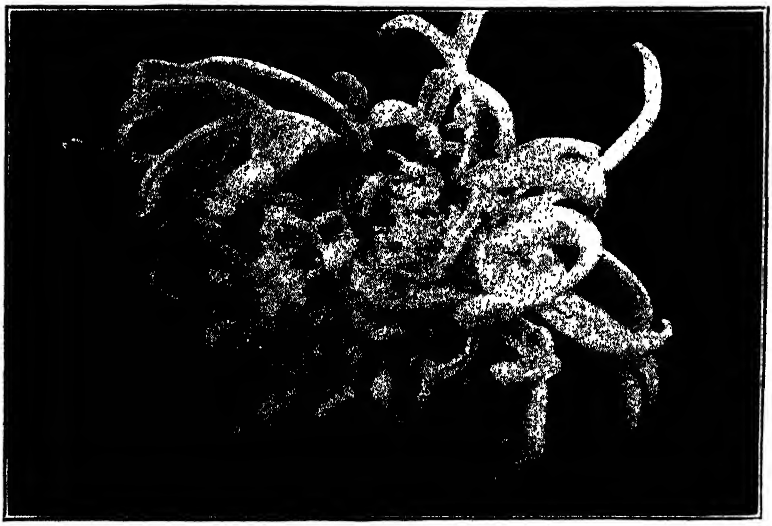


Fig. 3.—Chrysanthemum flower deformed by larvae of corn ear-worm Reduced.

About one month is required to produce a generation under optimum conditions, two or three weeks being required for the larva to complete its development.

There is a wide range of variation in the markings of both the adults and the larvae of the corn earworm. Some adult moths are pale yellow to nearly white, with faint markings, while other individuals are dark, dull, olive-green with dark veins and borders. They measure about one and one-half inches across their expanded wings.

The larvae may be marked with spots or stripes, and individuals from the same colony range in color from nearly black through brown to pale rose, dark green, or pale green. Mature larvae measure from one and one-fourth to one and one-half inches in length.

Both the corn earworm and the fall army-worm are killed by severe winters in the field, but under glass they survive. After the temperature drops to where the ventilators can be closed in the fall, an active

campaign can be profitably opened. Where sprays are used, pyrethrum will be found useful, but the most effective control measure yet known is hand-picking. Of course, hand-picking it tedious and one must be everlastingly at it in order to eradicate the pest. As a supplementary measure, the various extracts of pyrethrum have been found to be very effective when applied as sprays. The addition of a little ivory soap to most of the pyrethrum sprays increases their effectiveness. Before the buds open, many of the tiny larvae may be destroyed with entire safety to the plant by this method.

SAN JOSE SCALE RETURNS IN MICHIGAN

Fruit Growers Are Urged to Examine Orchards Carefully to Determine Prevalence of Pest

R. H. PETTIT, SECTION OF ENTOMOLOGY

San Jose Scale was found in Michigan in 1896, since which time the insect has become generally distributed all over the fruit-growing areas in the lower peninsula, excepting in the extreme northern section. During the 10 or 15 years immediately following the finding of the scale in Michigan, many fruit trees were killed and heavy losses were sustained. During this period, a great deal of work was carried on all over the eastern United States, and finally an effective and satisfactory method of control was developed, a control depending on the use of lime-sulphur applied during the dormant period.

The scale attacks apples, pears, peaches, sweet cherries, currants, plums, and a hundred or more ornamental trees and shrubs. Its appearance is well-known.

Tiny insects, smaller than a pinhead, are sheltered under coverings constructed of papery material. The insects and the scales are attached, or rather are plastered, on the bark of the tree. When not held in check, this insect multiplies at an amazing rate, each female being capable of having more than one and one-half million descendants during a single season at this latitude, providing that no natural enemies or adverse conditions cut down their increase. Of course, in nature, no such enormous increase occurs, although they do multiply amazingly and trees become quickly encrusted with the papery scales.

Following the period just mentioned, there came a time when the scale seemed to be losing its grip. The numbers of the insects gradually dwindled, until the control of the scale became merely a routine matter and some growers omitted the application of the dormant spray except at intervals of two or three years. A thorough investigation of conditions of that time, made by the Department of Entomology, showed that the dwindling of the enormous numbers of scales was due

to the development of large numbers of tiny parasites which searched out the insects and fed inside their bodies. For a number of years now, the parasites have continued to so regulate the affairs of the scale that little has been required, other than the application of a spray of oil-emulsion or lime-sulphur late in the dormant period just before growth starts.

Through no fault of our own or, for that matter, through no fault of the parasites, evil days have now fallen on these little helpers; and, consequently, the check imposed on the San Jose scale by the parasites has been partially removed and the scale has, consequently, begun to multiply, so that it is now far more plentiful in the lower part of Michigan than is realized by the growers. It has now established itself in numbers sufficient to bring about commercial injury in orchards in the southern part of the State.

Fig. 1.—Overwintering stage of San Jose scale. Greatly enlarged.

Every grower of fruits, except the growers of sour cherries and gooseberries, is urged to look over his trees carefully; and, if he finds the scale or anything that he suspects might be the scale, send specimens to the Department of Entomology for examination. If the scale is found to be present in appreciable numbers, plans should be made for applying a spray of lime-sulphur or of one of the miscible oils late in the dormant period, in fact just before growth starts. The San Jose scale is discussed and illustrated on page 60 of Circular Bulletin No. 137, which may be obtained for the asking. If further information is desired, it may be found in the Spray Calendar, which will also be sent to anyone in the State on request.

In conclusion, let it be understood that this return of the San Jose scale is merely one example of what is known as a biological fluctuation or, to use a more homely expression, the San Jose, like many other insects, passes through periods of ups and downs, and right at the present moment it is rapidly increasing. It is capable of doing serious damage if not checked immediately.

CONTROL OF CHERRY CASE-BEARER

Methods Tried in Michigan Succeed in Killing Insect Without Injury to Trees

RAY HUTSON, SECTION OF ENTOMOLOGY

During the past two seasons, cherry-growers in the vicinity of Old Mission have experienced losses from the work of cherry case-bearer, *Coleophora pruniella*. This pest, which normally feeds on wild black cherry, has, for some unknown reason, in the last few years changed its feeding habits to include cultivated cherry and apple. Fortunately, to date, the infestation in Michigan is restricted to cherry trees; this is fortunate in the sense that the insect is harder to control on apple trees than on cherry.

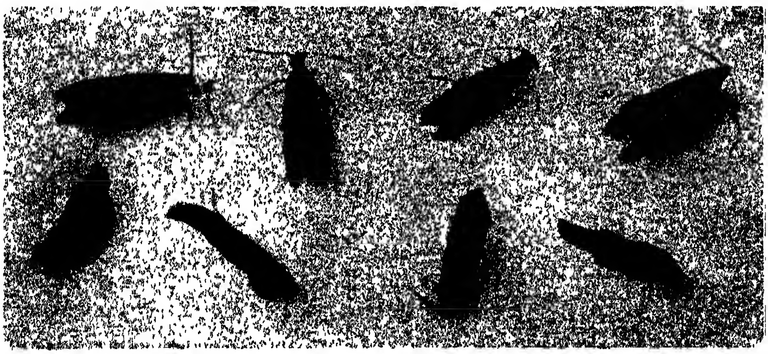


Fig. 1.—Adults and cases of cherry case-bearer. Enlarged about twice.

As this insect, as before stated, had not hitherto been a pest of cultivated fruit trees, the entire problem of its control had to be studied out. There was no fund of information about this insect, as there always is of insects that have been known for many years. The only things known about its control prior to last year were that it did not succumb readily to the ordinary means of control employed against most orchard insects and that certain oil sprays had been used, although with considerable risk of damaging the trees.

The 1930 tests showed that, unlike the pistol case-bearer, which is readily controlled by the use of various nicotine combinations to prevent the eggs from hatching, the cherry case-bearer did not respond to such treatment, either when combined with the regular fungicidal

spray schedule or when using the materials alone. The same is true of the various summer oils tried at the strength usually recommended. In addition to the nicotine and oil sprays tried out for the reason mentioned, several combinations of arsenicals applied at different times to poison the larvae gave equally unsatisfactory results.

During the last dormant season, in the spring of 1931, experiments designed to give further information on the proper concentrations and timing of oil sprays and tar washes and of the possibility of damage from the various sprays used were made in the vicinity of Old Mission. In these experiments, all the better-known miscible oils and oil emulsions were tried out, as well as home-made oil emulsions and two different brands of tar washes. The experiments demonstrated that a good degree of control could be expected from practically any of these materials when used at a sufficiently high concentration. It was also apparent that the lower concentration of these materials gave decreased kill. Just after the dormant season in May, 1931, some rather promis-

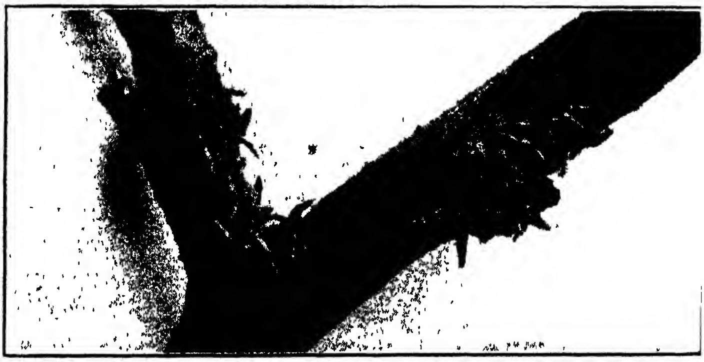


Fig. 2.—Winter cases of cherry case-bearer. Enlarged.

ing results with various combinations of nicotine and derris were secured when these materials were used against the case-bearers on the leaves.

The results of these experiments against cherry case-bearer indicate control methods which can be used successfully in fighting these pests. It seems that proprietary miscible oils, oil emulsions, and tar washes used at the dilutions recommended by the makers will give satisfactory control of cherry case-bearer during the dormant period. It is also apparent that home-made oil emulsions containing 6 and 8 per cent of actual oil will control case-bearer. All the oil sprays and tar washes should be applied during the strictly dormant season. The application of these materials for control of cherry case-bearers must be carried out in such a way as to hit the cases which remain upon the branches and twigs throughout the dormant season.

The absence of spray injury during the 1931 experiments cannot be relied upon for more than an indication of a reasonable tolerance to oil sprays by cherry trees and denotes, in the light of previous contradictory results, that care in the preparation of sprays, timing, and methods

of application will reduce to a minimum the danger of oil injury to cherry trees when spraying for control of cherry case-bearer. As nearly as can be determined from the data now on hand, the cherry tree must be covered to control cherry case-bearer, but care must be exercised to prevent over-spraying which is, apparently, a factor in oil injury.

METHOD TO REDUCE LOSSES CAUSED BY OX BOT

New Poison Can Be Used Without Endangering Cattle in Treated Herd

R. H PETTIT, SECTION OF ENTOMOLOGY

In Michigan, and here and there all over America, is a fly that in appearance closely resembles a small bumble-bee; a fly that deposits eggs on the heels of cattle. From these eggs, hatch tiny grubs that finally come to rest under the skin of the animal, always on the back. These grubs become noticeable in mid-winter, when the lumps that they cause can be felt by running the hand over the back of the animal The grubs are variously known as "ox-bots," "warbles," and "grubs-in-the-back."

In the Southwest, the adult flies are often called "heel-flies." The late fall, winter, and early spring is passed by the grubs snugly resting each in its own individual cell beneath the animal's skin, which it pierces at this point to provide for respiration. The grub itself finally reaches the size of the end-joint of one's finger; and, if nothing happens to interrupt its development, it is pushed out through the openings of the skin and finally falls to the ground, where it changes to a pupa and produces an adult fly the following May or June.

The mutilation incident to the operations of the grub cuts down the value of the hide. The loss caused by the work of this pest on hides alone amounts to many millions of dollars in the United States each year. Besides this, the annoyance and irritation due to the presence of the grubs decreases milk production in dairy cattle and the gain in flesh of beef cattle. Dr. F. C. Bishopp, of the United States Bureau of Entomology, estimates the annual loss in the United States resulting from the activities of this insect to be about $95,000,000. Practically all of the loss in Michigan could be avoided at small cost by the treatment which will be recommended to livestock men during the coming winter in Michigan.

Now, it happens that in India a tree grows from which is extracted a material variously known as derris, rotenone, and tuba toxin. It is an effective insect poison, and is coming into general use for spraying and dusting purposes. The interesting feature about derris is that while it is extremely poisonous to insects when taken even in minute amounts, its is entirely harmless to warm-blooded animals,

There is a derris compound called Gusanol now marketed in Michigan which, when applied in very small amounts over the opening of the skin above the bodies of the grubs, will kill the grubs without injury to the animal. The treatment is safe so far as any harm might result from one animal licking itself or from animals licking one another. This material should be applied in late February or March after the grubs have attained sufficient size to be easily found by rubbing the hand over the back of the animal, and before any of them have popped out and buried themselves under the surface of the soil.

Gusanol can be obtained at several points in the State, and the Department of Entomology will gladly furnish dealers addresses to any livestock grower who may be interested in using this product. The treatment consists in rubbing a small amount of Gusanol over the opening in the skin of the animal, through which the insect breathes. This should be done in February, or as soon as the warbles can be found by gently feeling for them with the fingers. Remove the scab over such an opening with the finger-nail and then place a small dab of the ointment and rub it in.

Not all of the warbles develop at the same time, and a second application is often necessary in March, and sometimes a third application in April to kill the larvae that are either too small to be noticeable the first time or those which were missed. This treatment is intended to kill the larvae, which will be forced out so that the wounds can heal. It is hoped that by the simultaneous treatment of most of the cattle infested in Michigan, so large a percentage of the bots will be destroyed that the remainder may be easily disposed of and the State finally be rid of or, rather, freed from the enormous tax imposed on beef and dairy cattle by these parasites.

In conclusion, it should be stated that the large black horse-fly, which is sometimes more than an inch long, has nothing to do with the grub-in-the-back of cattle. This horse-fly sucks blood from the animal, to be sure, but does not lay the eggs that produce the bot. The adult of the true bot-fly is about one-half inch long and resembles the bumble-bee. It is often found hovering about the heels of cattle in full sunlight, much to the disturbance of the animals. It is interesting to note that cattle kept in the shade are less likely to be attacked than those in full sunlight.

TESTS SHOW WAY TO CONTROL RASPBERRY MITES

RAY HUTSON, SECTION OF ENTOMOLOGY

Raspberry growers in southwestern Michigan have, for some years past, been suffering losses from three species of tiny mites on raspberry. Of the species concerned, *Tetranychus bimaculatus,* greenhouse red spider, is a well-known pest; while *Paratetranychus ilicis* has only been reported from South Carolina; and *Tetranychus mcdanieli* is a new species. These mites damage the leaves, which, as a result of their attacks, fall off. This condition, of

course, reduces the supply of plant food manufactured in the leaves for the use of the plant, and it affects the quantity and quality of the berry crop. Berries on plants with a large mite population do not ripen normally. In addition, with heavy infestations, the mites at times become so numerous that the fruit is literally covered with the pests.

Light infestations cause the foliage to assume a pale, unhealthy appearance which, on close examination, is found to be due to minute areas on the leaf surface, in which there is no green coloring. Leaves dusted very lightly with flour present a similar appearance.

During the winter of 1930-31, canes from various plantations in Berrien County, together with trash from the ground beneath, were studied. These showed that some of the mites go through the winter at the bases of the buds on the raspberry canes and beneath strips of loose bark. Confirmation of these findings concerning overwintering on the plant was obtained when the mites were observed in the field on the 27th of March, 1931, several weeks prior to the time when they had been hitherto recorded. No mites were observed to come from the trash, although from what is known of mite habits it was to be expected.

The demonstration of the overwintering habits of these mites is important, since greenhouse red spiders normally go through the winter in other places and migrate to the raspberry canes at a later period, while the over-wintering habits of the other two species were unknown. The greenhouse red spider has a host-list of over 150 plants, including all the common weeds that grow in raspberry plantings.

The knowledge that some of the mites over-winter on the raspberry canes suggested the following lines of investigation: (1) Supplementary control measures, such as the removal of old canes, and (2) spray treatments early in the season before the mites increase in numbers and before the foliage has developed to a point where thorough coverage is hard to accomplish.

The spraying experiments for control of mites infesting raspberries were considerably lengthened by the fact that little was known concerning the tolerance of raspberry foliage to various sprays that could be used. Consequently, it was necessary to proceed slowly. Many sprays were tried. Among them were glue, oil, nicotine, pyrethrum, derris, soap, and as many of the combinations as time permitted.

The most striking feature of the preliminary experiments with these various substances was that any of them could be depended upon to kill between 50 and 70 per cent of the adult mites present on the leaves; but, after a week or 10 days had passed, there was little difference between sprayed plots receiving one application and its check. Taking these facts into consideration, new plots were laid out and given two and three applications of the materials at intervals of five days. The outcome of the second series of experiments demonstrated that summer oils used at 1 per cent strength, alone or in combination with Bordeaux controlled the pests. Nicotine and penetrol, derrisol and soap, and glue were three other successful sprays.

On the bases of cost, ease of application, compatability, and tolerance of the plant, the summer oils, Volck and Verdol, used at 1 per cent strength seemed, as a result of these tests, the most satisfactory killing agents for controlling the spinning mites infesting raspberries.

At the conclusion of the insecticidal tests, some supplementary in-

formation concerning the tolerance of raspberry plants to repeated applications of 1 per cent oil seemed desirable. A row of raspberries was, therefore, selected and sprayed every Monday morning with 1 per cent summer oil for a period of nine weeks. No oil injury was apparent at the end of the time; therefore, it is concluded that raspberry plants are very tolerant to 1 per cent solutions of the summer oils, Volck and Verdol.

Studies made at the same time the spray tests were going on showed several conditions favorable to the building up of mite infestations. The most apparent is the practice of deferring the removal of spent canes. Such canes teem with mites in infested patches and hinder any complete spray coverage of the new canes. The remedy for this condition is plainly indicated. Cut out the old canes as soon as the fruit is picked and burn them while green to prevent migration of the mites. In many mite-infested patches, host plants, particularly sow thistle (*Sonchus arvensis*), are abundant. Clean cultivation will eliminate such reservoirs of infestation. Mites do not seem to occur as frequently on soils with good water-holding capacity.

These studies indicate that mite control can be brought about without injury to the raspberry plant by three thorough sprayings (about 1 gallon of spray to each rod of raspberry row) at intervals of five days.

The summer oils, Volck and Verdol, at 1 per cent strength with or without Bordeaux, furnish satisfactory control. A series of three sprays should be applied as soon as the plants begin to show green. Any recurrence can be controlled in the same way. Such a spray treatment applied after cutting and burning all old canes will reduce the number of mites going into the winter and help to produce the vigorous young canes necessary for the next year's crop.

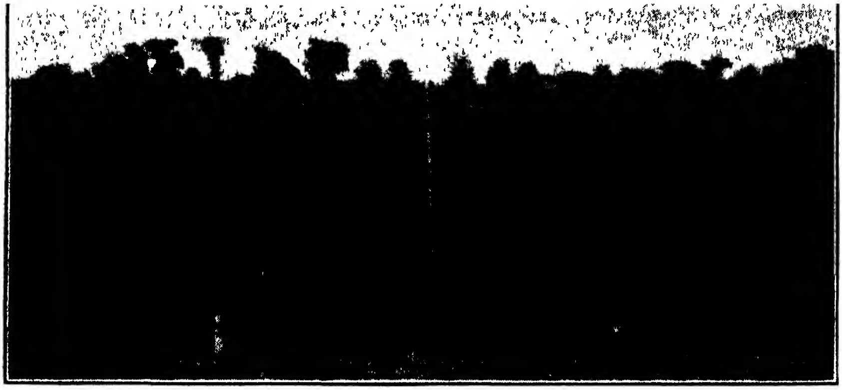
MARKTON OATS NEED NO TREATMENT FOR SMUT

This Variety is Adapted For Use in Parts of Michigan

H. C. RATHER, E. E. DOWN, AND G. F. WENNER,
SECTION OF FARM CROPS

The control of the smuts of oats is one of the disagreeable jobs with which farmers contend. Coming along with the rush of spring work and involving the unpleasant task of using irritating chemicals, the treatment of seed oats frequently is neglected.

The costs for labor and materials with which to treat the seed are not large on any one farm, are only three or four cents an acre for chemicals where formaldehyde is used, or about 15 cents an acre for the more conveniently applied mercury dust compounds. In the aggregate, this bill for labor and materials in Michigan amounts approxi-

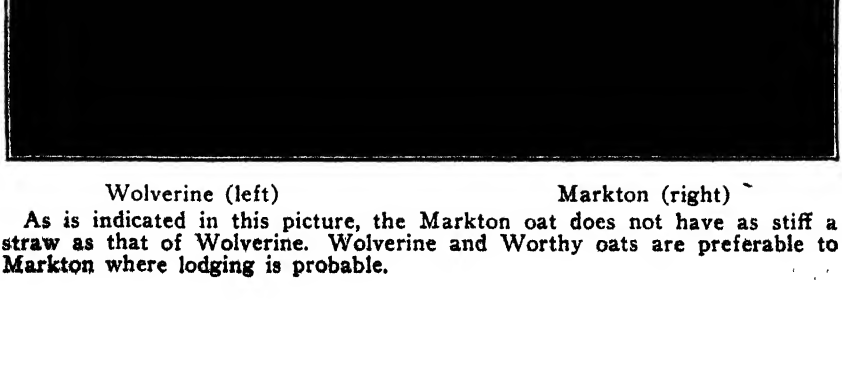


Markton (left) Wolverine (right)

The Markton oat is equal to the Wolverine variety in yielding ability and has the advantage of being essentially immune to smut. Where soil conditions are such that lodging is unlikely the Markton oat should prove to be a very desirable variety for Michigan farmers.

mately to $150,000 annually, or would amount to this sum provided all seed oats used in the State each season were properly treated. Actually, the oat smut bill is much larger than this sum because the seed used on thousands of acres is not treated and the loss in yield and quality of the resultant smutty oats is much greater than the cost of seed treatment. The cost of treating seed oats to control smut is one of those expenses which all growers bear whether they treat their seed or not.

Of interest, therefore, to the hundred thousand oat growers of Michigan are the recent developments in plant breeding which have made available varieties of oats which do not need to be treated to control smut. These varieties have an inherent resistance to the disease, the



Wolverine (left) Markton (right)

As is indicated in this picture, the Markton oat does not have as stiff a straw as that of Wolverine. Wolverine and Worthy oats are preferable to Markton where lodging is probable.

development of smutted plants in them is exceedingly rare even when the seed is artificially smutted to a very high degree.

A noteworthy variety in this regard is the Markton oat, a selection made in Oregon in 1911 from an unnamed variety. The original unnamed oat was obtained by the United States Department of Agriculture at the Louisiana Purchase Exposition in 1904 and is said to be of Turkish origin.

T. R. Stanton and Associates[1] describe the Markton oat as an erect, short to mid-tall, mid-season variety with branching panicles. The kernels are yellowish white, long, and slender, with a rather thin hull. According to the findings of these experimentors, the Markton oat is immune from covered smut.

Trials by the Botany Section[2] of this Station in 1928 support these findings. In these trials, a portion of each lot of seed was heavily inoculated with loose smut of oats, another portion with covered smut of oats, while a third portion of the seed was untreated. The late spring and wet season of 1928 favored smut development and farmers reported heavy oat smut infection as being general over Michigan. A comparison of Wolverine, Victory, and Markton oats in these smut trials is given in Table 1.

Table 1.—Wolverine, Victory, and Markton varieties compared as to susceptibility to the smuts of oats.

	From Unsmutted Seed			From Smutted Seed		
	Wolverine	Victory	Markton	Wolverine	Victory	Markton
Number of heads	637	505	536	457	473	482
Number of heads with loose smut	15	11	0	67	99	2
Number of heads with covered smut	0	0	0	33	75	1
Per cent heads with loose smut	2 4	2 2	0	14 7	20 9	trace
Per cent heads with covered smut	0 0	0 0	0 0	7 2	15 9	trace

Its high degree of smut resistance is the chief characteristic which recommends Markton oats to Michigan farmers since seed treatment to control smut, in the case of this variety, is apparently unnecessary. In order that Michigan farmers may decide whether or not to grow Markton oats, its comparison with Wolverine oats is here given. The Wolverine oat is the most widely grown variety in the lower peninsula of Michigan. Down,[2] Brown, and Clark report that no variety has as yet significantly outyielded Wolverine oats in tests at this Station. When a new oat finds a place in Michigan's cropping program, it will need characteristics which make it a worthy competitor of the Wolverine variety. In respect to yield, the Markton oat meets this requirement. In numerous Michigan tests recorded in Tables 2, 3, and 4,

[1]Stanton, T. R., Stephens, D. E., and Gaines, E. F. "Markton, An Oat Variety Immune From Covered Smut." U. S. D. A. Circ. 324, 1924.

[2]Down, E. E., Brown, H. M., and Clark, F. H. "Oat Tests at the Michigan Experiment Station." Mich. Exp. Sta. Sp. Bul. 197. 1930.

Table 2.—Wolverine and Markton oats in the Michigan Experiment Station Oat Breeding Nursery at East Lansing.* (Yields in per cent.)

	Markton	Wolverine
1925	102 9%	100%
1926	98 7	100
1927	104 8	100
1928	97 5	100
1929	94 8	100
1930.	103 3	100
Average per cent	100 3	100

*Conducted by E. E. Down

Table 3.—Wolverine and Markton oats in other Experiment Station trials.* (Yields in bushels per acre.)

	Markton	Wolverine
East Lansing—1930	41 27	41 47
Lake City (light soil)—1930	30 1	31 8
Lake City (heavy soil)—1930	48 5	48 2
East Lansing—1931 (Test a)	66 6	75 0
East Lansing—1931 (Test b)	83 3	90 1
Average	53 95	57 32

*Conducted by J. W. Thayer, Jr., and W F. Russow.

Table 4.—Wolverine and Markton oat in over-state trials.* (Yield in bushels per acre.)

	Markton	Wolverine
Lenawee County—1930	82 14	70 09
Monroe County—1930	74.99	67.53
Tuscola County—1930	63 59	61.44
Lenawee County—1931	18.54	13.00
Arenac County—1931	39 09	27.20
Montmorency County—1931	22 25	27.91
Manistee County—1931	12.67	14.87
Macomb County—1931	47.20	54.18
Average	41.94	40.83

*Conducted by G. F. Wenner.

the Markton variety appears to be equal in productivity to the Wolverine.

From the standpoint of quality of grain, there is little to choose between the two varieties. In the yield trials recorded above, the weight per bushel of Markton oats has not differed greatly from that of Wolverine oats or any other of the good mid-season varieties. In color, the Wolverine is distinctly a white oat while the Markton grain is yellowish white. The shape of kernels of the two varieties is much the same and so is the proportion of hull to kernel.

The Wolverine oat has a longer, coarser, and stiffer straw than the Markton variety. This difference was very apparent in the season of 1931 when lodging was prevalent in many of the trial fields. Wherever this was the case, the straw of Markton oats lodged earlier in the season and over a larger area than did the straw of Wolverine. On the lighter types of soil, no lodging occurred with either variety and for growers whose soil is predominately of the sandy loam and lighter types the Markton oats should not go down sufficiently to cause serious trouble. However, on the heavier soils or on those high in organic matter where lodging of oats often is a problem, such varieties as Wolverine and Worthy oats will give less trouble than Markton.

Although in trials by Churchill[3] at the Upper Peninsula Experiment Station, Chatham, Michigan, the smut resistance of Markton oats has been demonstrated, the variety has not done nearly as well in Northern Michigan as it has in the lower peninsula. Stem rust of oats is far more prevalent in that section than it is farther south and the Markton oats like Wolverine and many other varieties is susceptible to this disease. Iogold oats, an early rust resistant variety developed by the Iowa Experiment Station, usually outyields both Wolverine and Markton in the Upper Peninsula.

In the spring of 1931, 25 bushels of pure Markton seed were secured from the Washington Experiment Station, Pullman, Washington, and planted by the Farm Crops Section of this Station in three small increase areas. On one of these, a Berrien sandy loam, the yield was 62 bushels an acre; on another area, Hillsdale sandy loam, 67 bushels an acre; while on the third area, a low-lying Conover loam the acre yield was 83 bushels. The seed from these areas has been released to the Michigan Crop Improvement Association to start, in a large way, production of certified seed of Markton oats for distribution generally to Michigan farmers with growing conditions to which this variety is adapted.

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[3]Churchill, B. R. "Investigations with Oat Varieties in the Upper Peninsula." Mich. Exp. Sta. Sp. Bul. 213. 1931.

The following chart is designed to aid growers in choosing a well adapted oat variety.

Oat Variety Chart.

Variety	Adaptation	Advantages	Disadvantages
Markton	Lighter soil types of Lower Peninsula on which oat straw seldom lodges	Need not be treated for smut; high yield, good quality.	Straw not so stiff as that of Wolverine and Worthy, susceptible to stem rust.
Wolverine	Good upland soils outside those northern areas where stem rust often is serious	High yield, good quality, tall, stiff straw.	Susceptible to stem rust and oat smuts (1)
Worthy	Low lying heavy soils and others where lodging is likely	Stiff straw, good quality, and yield	Susceptible to stem rust and oat smuts (1), not as productive as Markton and Wolverine when lodging is not a factor.
Iogold	Upper Peninsula and other northern Michigan regions where stem rust often causes heavy losses	Resistance to stem rust, good yield, early maturity; a good nurse crop for seedings of clover and alfalfa	Susceptible to oat smuts; (1) short straw, small kernels, yellow color

(1) Write to Michigan State College, East Lansing, Michigan for Extension Bulletin No. 13 (Revised), "Oat Smut and Its Control."

RECOMMEND TWO NEW APPLES FOR SPECIAL MARKETS

WALTER TOENJES, SECTION OF HORTICULTURE

A number of the newer apple varieties which appear to have some meritorious qualities are being tested at the Graham Horticultural Experiment Station at Grand Rapids. Historical and descriptive accounts of two varieties that have recently fruited, together with comments regarding their apparent possibilities for Michigan conditions, are given in this article.

Lodi—This variety originated as a cross between Montgomery and Yellow Transparent at the New York Agricultural Experiment Station in 1912. It was introduced to the trade in 1924.

The tree is of the Yellow Transparent type, but appears to be more vigorous. It is productive, and its ability to carry heavy loads without splitting is indicated by its strong wide crotches.

The fruit also is of the Transparent type. It is uniform, roundish conic, with an attractive pale greenish yellow color. It averages considerably larger than the Yellow Transparent, is less easily bruised, ripens from four to seven days later and keeps longer than that variety. The fruit does not have a tendency to become mealy and soft at the

center so quickly as its parent. The flesh is white, firm, tender, and juicy, with good quality. Sprightly in flavor at first, upon fully ripening the flavor becomes mild and pleasantly aromatic.

The later ripening of this variety coupled with its superior qualities, as compared with Yellow Transparent, makes Lodi appear very promising. This is especially true where it is desired to prolong the season of this type of apple, either for roadside marketing or for other special demands. Its limited planting, therefore, can be recommended.

Milton—This variety also comes from the New York Agricultural Experiment Station where it originated in 1910, and was introduced in 1923. It is the result of a cross between Yellow Transparent and McIntosh, resembling the latter variety in type of tree and fruit. The tree is vigorous, healthy, and productive, and has wide strong crotches which enable it to carry heavy crops without splitting.

The fruit resembles McIntosh in taste and aroma, but is likely to be a little less symmetrical in shape than that variety. Its ground color is a pale yellow with a pinkish-red to red covering. The fruit has a rather heavy conspicuous bloom. Apples growing in the shade take on a mottled pinkish appearance, while those developing on exposed branches range from a dark pink-red on the lower side to solid red on the exposed cheek. The fruit compares with that of McIntosh in size and ease of bruising, the latter characteristic necessitating careful handling. The flesh is white, tender, crisp, and juicy, with a pleasant aromatic flavor; the quality is excellent.

Milton matures along with Wealthy, at a season when a good eating apple is in demand and it promises to replace that variety to some extent. This new variety appears to be particularly well suited to roadside marketing or the local trade. It should be given at least limited commercial trial in Michigan.

NEW PEACH RECOMMENDED FOR LIMITED PLANTINGS

STANLEY JOHNSTON, SECTION OF HORTICULTURE

A review of the history of peach varieties in Michigan shows that no variety of lasting importance has been found that matures its fruit more than a week or 10 days earlier than Elberta. Various faults have caused the abandonment of many varieties.

St. John and Early Crawford were too unproductive to be profitable. Barnard, Judd, and Admiral Dewey were too small, extremely pubescent, and subject to rot. Rochester and South Haven are the only two early maturing varieties of any considerable importance now being grown in this state and they have serious weaknesses. Rochester, though hardy and productive, produces too many small peaches, is very pubescent, is subject to rot and does not ship well. South Haven

is productive of high quality fruit but lack of color, an inclination to cling to the pit during certain seasons, and inability to ship long distances have curtailed the popularity of an otherwise splendid variety.

Many varieties have been tested and some breeding work has been done at the South Haven Experiment Station in an effort to find suitable varieties maturing considerably earlier than Elberta, a season that is often profitable for Michigan peach growers. As a result of breeding work a promising cross between J. H. Hale and South Haven was produced and has been named Halehaven.

The cross from which the Halehaven originated was made in 1924. The original tree started bearing the third year and young trees budded from the parent tree started bearing the second year. The tree grows much like the South Haven and the foliage of the two varieties is almost identical in appearance.

The fruit of the new variety averages a little larger than South Haven, matures with South Haven, but is much higher colored, the color appearing while the fruit is still firm. Its skin is intermediate in toughness between that of J. H. Hale and South Haven. Its high color permits earlier picking, and its somewhat thicker skin should make Halehaven ship better than many early peaches now on the market. The flesh is yellow and of excellent quality, comparable with South Haven. The pit is entirely free.

It is always hazardous to make predictions as to how any new variety will perform when grown in large quantities under many different conditions. Therefore, new varieties should always be tested in a limited way before being extensively planted. The evidence available indicates that Halehaven is worthy of trial by commercial growers who are interested in an early maturing variety.

THE RELATIONSHIP BETWEEN SOIL PROFILE AND ROOT DEVELOPMENT OF FRUIT TREES

N. L. PARTRIDGE AND J. O. VEATCH,
SECTIONS OF HORTICULTURE AND SOILS

The growth of shoots and roots of fruit trees are mutually dependent for the supply of the foods, chemical compounds, and elements necessary for their development. Vigorous shoot growth which is essential for profitable fruit production thus depends upon the development of an extensive root system and the ability of the soil to furnish the moisture and mineral salts used by the top. The demands on the soil are large when the plants reach maturity.

The extent and the character of the root system are influenced by variations in the texture, structure, chemical nature, and thickness of the separate layers of the soil, as has been shown by Weaver (3, 4) and other investigators. The Sections of Horticulture and Soils of

Michigan State College have been engaged in an examination of the influence of the soil variations found in southwestern Michigan on root development and tree vigor.

Two reports which have been published (1, 2) show that growth and productivity are greatly influenced by the character of the soil. The depth to a waterlogged layer or to hardpans proved most important in a raspberry planting on a poorly drained soil. The thickness of the humus soil proved to be closely correlated with the growth and production of grapevines set on a well drained sandy soil.

The soils of southwestern Michigan are very diverse in character. The extreme variations range from a nearly pure dune sand to stiff, hard clay; from droughty to excessively wet; from soils very low in organic matter to mucks and peats; from highly acid to high in lime: and from very low to high in elements of fertility. Though fruit trees have been planted and exist on most of the soils, they differ considerably in vigor and productivity. The variability in the profile character of the soil causes differences in the development of the root systems which are reflected in the ability of the plant to obtain its requirements of moisture and mineral salts.

Typical Root Systems in Good Soils

With these diverse soil conditions influencing root development, it is difficult to determine what form of root system is typical for any particular fruit plant. However, the root system of a fruit tree growing on a friable, penetrable, sandy loam or light loam soil with good drainage in the surface horizons, such as the Bellefontaine type, seems to be fairly representative in character. In a root system of this sort (see Figue 1), most of the roots are found in the upper one and one-half to two feet of soil, comprising the A horizons. In both sod and cultivated orchards, the densest root development is usually from six to eight inches below the surface. Often this mat of roots is found in the upper portion of the A_2 horizon, just below the A_1 horizon. If the A_1, which contains the largest amount of organic matter, is very thick the greatest root development may occur in it, but where this layer is less than six inches in thickness, the greatest root development may be in the underlying soil horizons. In orchards where a mulch sufficient to prevent the growth of weeds has been maintained, the tree roots extend upward toward the surface of the soil and sometimes even enter the lower portions of the mulching material if this remains moist. It is not unlikely that the relative development of roots in the A_1 horizon depends on the permanence and uniformity of its moisture supply.

The B horizon contains a variable percentage of the roots, largely depending on the thickness of this layer. In most instances, the weight of roots per cubic foot occurring in this horizon is less than in the A horizon. Owing to the accumulation of clay, the B layer is sometimes rather tough and hard, but the tree roots are usually able to penetrate it without much difficulty.

There is a smaller weight of roots per cubic foot in the C horizon than in the B. Even with the large space which may be exploited by the roots, the total weight of roots in this horizon is often comparatively small. However, it is not thought that the relative importance

of different portions of the root system can be evaluated entirely on a basis of quantity of roots, alone. The lower portion of the root system is characterized by roots which tend to penetrate to considerable depths. Under favorable conditions terminal mats of fibrous roots are developed in portions of the soil which are permanently moist. The depth of root penetration is determined by the age of the tree, the depth to the water supply, and any conditions of the upper soil which may favor or retard the rate of root development. In some instances, the roots reach a depth of 20 feet or more.

The root system of the type described above, furnishes the plant with two sets of fibrous roots. The upper set is located in the surface soil, in which the larger portion of the organic matter is found and from which the plant obtains the major portion of its nitrogen and probably the larger part of the phosphorus, potash, and other mineral salts which are more available in the presence of decaying organic matter. During periods when the surface soil is moist, these roots probably supply the greater part of the water used by the tree.

The lower system reaches greater depths and, if the soil conditions are favorable, taps a more permanent water supply. This reserve supply of water is important during periods of drought when the upper portion of the soil becomes very dry. The number of these roots and their absorbing surface may be rather limited, but their capacity to supply the tree seems to be sufficient, provided they reach moist soil. The ability of a few roots to supply considerable moisture is illustrated by the manner in which an uprooted tree is able to supply its leaves with sufficient moisture to avoid wilting or leaf fall when the few remaining attached roots are located in a moist environment. Grapevines have been observed which had all their surface roots exposed by erosion and still were able to supply their leaves with sufficient moisture to avoid wilting from the few deep-running roots which were still in the soil.

In the more clayey soils, the eventual pattern of the roots is apparently very similar to that found in the sandier soils, although deep penetration may be slower and the proportionate amount of root development in the various horizons may vary somewhat. Thick mats of fibrous roots apparently do not occur in the heavier subsoils. In rather limited excavations on the heavier soils, evidence of deep rooting has been found; at East Lansing, the roots of an old apple tree were traced to a depth of eight feet in compact massive clay, at which point they entered more open sandy material.

Types of Root Systems Produced in Unsatisfactory Soils

Variations in the profile character of the soil may prevent the formation of the type of root system just described. In tracing the course of roots of fruit trees exposed by excavations, repeated observations have shown that hardpans are usually avoided, the roots growing around or above the cemented soil. In clay, such as in the B and C horizons of the Miami type, the roots follow cracks between the blocks of clay and develop fan-like mats. If a compact subsoil varies in density, roots are more numerous in the less compact portions. In lighter subsoils, roots are more abundant in the more loamy portions, possibly because of the larger supply of moisture there. If channels of penetrable soil

exist through which the roots of a tree may grow into the lower soil, they will do so sooner or later. However, there are some profile characters which prevent deep root penetration.

When the characteristics of the soil profile prevent the establishment of the deeper roots in a soil horizon permanently supplied with moisture, the tree is much more sensitive to variations in seasonal rainfall than is otherwise the case and it suffers more frequently from summer droughts. Trees in these situations lead a precarious existence; they may grow well during a series of favorable seasons, but this same vigorous growth may make them unfitted to withstand a series of unfavorable seasons. The time in the life of the orchard when the moisture supply will become deficient will depend on the planting distance and the water holding capacity of the exploited horizons as well as on seasonal conditions.

In southwestern Michigan, the most common factor preventing deep root penetration is poor drainage, as is illustrated by the Allendale fine sandy loam. Here the height of the water table fluctuates widely due to variations in the seasonal or annual precipitation; the high stages restrict root development to those portions of the soil which are likely to become very dry with a lower water table. This condition results in dwarfing the tree to an extent governed by the depth and water-retaining capacity of the constantly well-aerated horizon to which the roots are restricted.

A second profile which may prevent the roots from reaching a permanent source of water is a very deep, pervious and dry sand such as characterizes the material underlying the Plainfield and Bridgman sand types. Roots penetrate deeply into these soils, but apparently they are unable to obtain sufficient water during long periods of drought.

A third unfavorable soil condition is that in which the B subsoil horizon is so compact or poorly aerated that the development of the deeper root system may be delayed or possibly prevented. Some phases of the Nappance silt loam have a subsoil of this type.

Older May Do Better Than Younger Trees on Certain Soils

The development of an extensive rooting system characteristic of a mature tree takes a considerable period of time. Consequently, a particular profile may provide an environment which is not equally favorable to the tree at all stages of its development, depending on the horizons which have been reached by the root system. For example, apple trees less than 10 years old, set on Miami silt loam in Berrien county, had many brown leaves and their general appearance indicated that their soil environment was unable to supply sufficient moisture. At the same time, neighboring well established trees set over 25 years on the same soil type were green and vigorous in spite of their larger water requirement. The older trees had had a longer time in which to develop their root systems and so were better able to exploit this particular soil profile. A similar condition was observed on a dry open sand near Beulah, where excavation revealed at a depth of eight feet roots which had reached a moist horizon in the sand (Figure 1). The outer five or six annual rings of the trunk were much thicker than the inner, probably due to the more favorable water relations after the deep roots were established. However, a profile may be more favorable

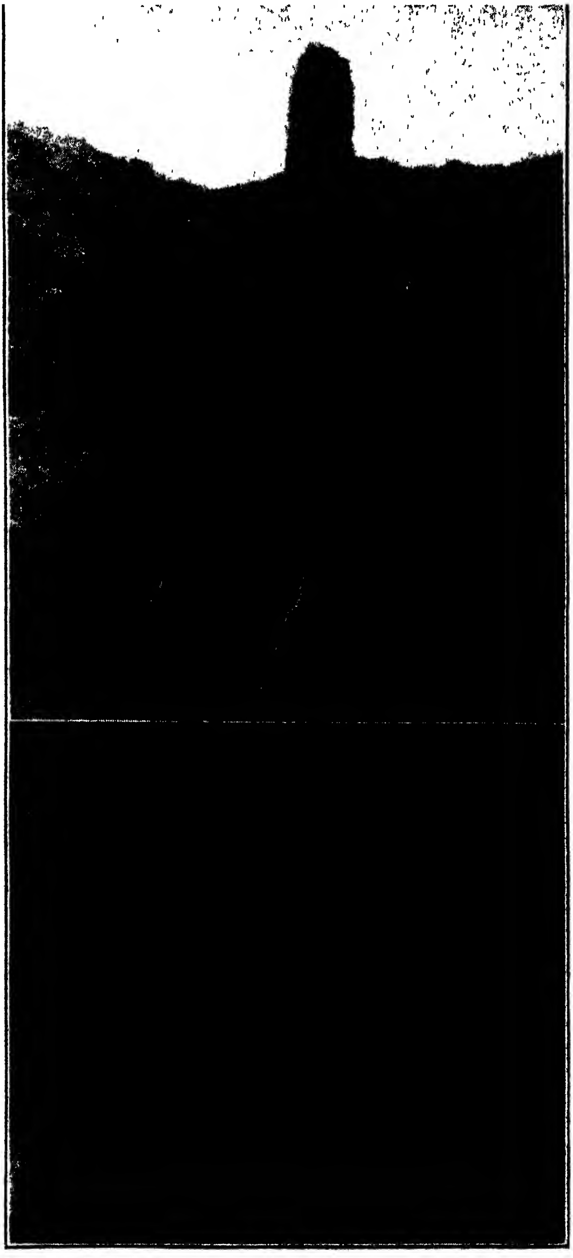

Fig. 1.—Root development of twenty-one year old apple tree on infertile sandy soil. The numerous roots in the surface (A) horizon droop because of the removal of soil; they are nearly horizontal naturally. The horizon of compaction (B) is represented by a hard, somewhat cemented sandy layer which lies just beneath the horizontal section of the vertical root. The unweathered horizon (C) is penetrated until moisture is reached at a depth of about eight feet below the surface. Here the vertical root, shown in the picture, turns horizontally and throws out numerous laterals in the moist sandy layer.

to the early development of the tree, as a shallow soil is able to supply the moisture requirements of the young tree but not the greater demands of the mature tree.

The Relative Importance of the Surface Layer

Although the subsoil characteristics have a profound influence on the development of the fruit tree, the upper horizons also enter the environmental complex. This is illustrated by data secured in an apple orchard near Galesburg, Kalamazoo county, which is set on Bellefontaine fine sandy loam and Washtenaw silt loam. Photographs of three of these trees are presented in Figure 2. The profile of the Bellefontaine has been so altered by erosion, that some of the trees were set in the A, a few in the B, and others in the C horizons. The soil of the Washtenaw type reached a thickness of approximately 10 feet in the lower spots where the greatest deposition had occurred. The apple trees, set in 1918, on the deep A horizon averaged 24.9 inches in circumference, with a height of 18.9 feet and a spread of 14.4 feet. Those trees set on uneroded Bellefontaine soil or where erosion had been slight averaged 19.9 inches in circumference, a height of 15.2 feet and a spread of 11.5 feet. Trees which had been set in the C horizon averaged 16.2 inches in circumference, a height of 14.4 feet and a spread of 10.7 feet. Since the roots of all these trees had penetrated into the C horizon, the differences in growth response must, apparently, be associated with differences in the thickness of the surface soil, its content of organic matter and available nitrogen and the waterholding capacity of the surface horizons which have been exploited by the root system.

From the ecological point of view, the soils of southwestern Michigan may be divided into two groups, with some intermediate types. The first group comprises those soils whose profiles prevent the development of a deep root system capable of supplying sufficient moisture during droughts, such as the poorly drained Allendale fine sandy loam, the very dry, deep Bridgman sands, and very compact soils such as some phases of the Nappanee silt loam. For fruit tree development, these very diverse soils are almost equally unfavorable because they all fail to provide a permanent supply of water for the tree. Cost of production per bushel of fruit is always inordinately high and planting trees on them is generally inadvisable. Attempts to establish orchards on these soils result in considerable losses which could be avoided by an examination of the soil.

The soils that permit the root system to reach the more permanent moisture of the subsoil may also be grouped, though the soils differ considerably in their suitability for fruit production. The length of time required for reaching the deeper moisture stores varies with the profile not only because of differences in the distance to be traversed but also because of variations in the penetrability of the intervening horizons. Furthermore, these soils vary in the ability of the upper soil horizons to supply the tree pending its final adjustment to its environment. A fertile surface soil will advance the top growth of the young tree and so increase the rate of root development. The variations in the upper portions of the soil continue to be important after the establishment of the mature tree if they involve differences in the ability of the soil to supply mineral elements, particularly nitrogen.

Fig. 2.—All of these trees were set in 1918 and photographed in June, 1931. The smallest is on a slope where the more fertile soil was washed away by erosion and it was set in the C horizon. The center tree was set on an uneroded spot where all the soil horizons are intact. The largest tree was set in a hollow on a deep silt soil where the A horizons, built up by the deposition of eroded soil, are nearly ten feet thick and the tree is exceptionally well supplied with moisture and mineral elements. All of these trees have been fertilized with nitrogen, nearly every year since they were set.

Variations constituting phases within one type of soil, frequently due to erosion, may sometimes influence fruit tree growth more than differences between some of the broader units or types of the soil classification. This is possible because some dissimilar profile characters may equally prevent, retard, or favor root penetration, permitting rather minor surface soil variations to exert a predominating influence on the development of the tree. However, the significance of the phase, such as a variation due to erosion, is local while that of the type, or broader unit, is regional.

The orchardist should know how the roots of his fruit trees are likely to develop in the soil on which he intends to set his orchard. Considerable information can be obtained from a few holes made on the prospective site. In general, fruit should not be set on soils which are underlain by impenetrable subsoils or hardpans or which have subsoils that are poorly drained and aerated, indicated by the presence of bluish-gray or grayish and yellow mottled layers. Some of these soils may be reclaimed by breaking the hardpan by deep tillage, by dynamiting, or by drainage; but others cannot be successfully improved even by these methods. Deep sand soils are not likely to be as valuable as those which are underlain by clay. Naturally well drained soils with a clayey but friable and penetrable subsoil and a good supply of humus in the surface layer have generally proved most satisfactory for fruit production. Sites which are naturally frosty should not be set, even if the soil is favorable.

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CLARIFING CIDER INCREASES DEMANDS FROM CONSUMERS

Proper Methods Produce Product For Which the Public Will Pay Higher Price

ROY E. MARSHALL, SECTION OF HORTICULTURE

A recent publication of the New York Agricultural Experiment Station[1] describes a practical method for producing a brilliantly clear and transparent apple cider. The clarifying agent is an enzyme produced by a mold (Penicillium glaucum). The action of this enzyme preparation is purely chemical. It flocculates the colloidal material, which is responsible for the cloudy condition of cider, thereby producing a sediment which is easily removed by siphoning or ordinary methods of filtration. This enzyme preparation, produced commercially under the trade name of pectinol, is a clear amber, practically tasteless liquid which adds nothing or takes nothing from the natural flavor of fruit juices.

With the development of this material for clarification of fruit juices, this Station became interested in the possibilities of producing a more attractive apple cider and in a study of the effect of such clarification on the merchandizing of the product. After a few preliminary tests, equipment was installed for filtration on a small commercial scale of the cider to which the enzyme preparation has been added.

Consumer Demand

Before the filtering equipment was ready for use, the Horticultural Department established 25 cents retail and 20 cents wholesale as its net prices for ordinary cider. An additional deposit of 20 cents was made for gallon glass jugs. When ready to offer the clarified product an additional 5 cents was asked per gallon. Both kinds of cider were displayed and the customer was allowed his choice at the price differential. The demand for cider immediately increased, running to more than 400 gallons some weeks while in previous years the sales for a week seldom exceeded 100 gallons. After the two kinds of cider had been offered for about six weeks and any novelty of the clarified cider had disappeared, a record was kept of retail and wholesale sales of the two kinds for one week. This happened to be a week of lighter sales than the previous or succeeding weeks but it is believed the proportionate sales are representative of a typical week.

[1]Kertesz, Z. I. "A New Method for Enzymic Clarification of Unfermented Apple Juice." N. Y. Agr. Exp. Sta. Bul. No. 589. 1930.

Table 1.—Sales of ordinary and clarified-filtered cider. Week of November 9.

	Retail Sales		Wholesale Sales		Total Sales	
	Clarified	Not Clarified	Clarified	Not Clarified	Clarified	Not Clarified
Gallons	145	22	50	10	195	32
Per cent of total	64	10	22	4	86	14

There was only one call for a wholesale quantity of cider that had not been clarified and it was accompanied by the statement, "We are serving in paper cups so the guests will not know the difference."

There were no calls for the ordinary cider by consumers on two days of the six while not less than 22 gallons of clarified were sold any day.

Fig. 1.—Gallon glass jugs are satisfactory containers for the merchandizing of cider. The cider in jug A was strained twice through two thicknesses of cheese cloth. That in jug B was subjected to enzymic clarification, followed by filtration. Note that the unfiltered product is opaque while that which was filtered is clear enough so that the figures on the calendar behind it are clearly visible.

Nevertheless, a few regular customers prefer the ordinary cider regardless of price while many prefer the taste of the clarified. A fair statement would be that blindfolded persons would be as likely to prefer one as the other and that any preferences on the basis of taste or flavor are prejudiced by the difference in appearance.

During a 10 day period beginning October 23, ordinary iced cider was offered in competition with seven other drinks for lunch and dinner at a Lansing cafeteria whose patrons probably represent a good cross section of people patronizing such establishments. Clarified iced cider was then substituted for the ordinary cider for a 10 day period. The ordinary cider was priced at five cents and the clarified at six cents per glass, there being about 14 glasses per gallon.

Table 2.—Comparative demand for ciders at cafeteria.

	Total meals served	Number cider servings	Ratio cider servings to total meals	Gain in consumption	Gross profit per gallon to the cafeteria
Ordinary	6102	154	1 to 40		50 cents
Clarified	5745	210	1 to 27	45 per cent	59 cents

The important item in this table is that 45 per cent more cider was sold after the more attractive product was offered. Furthermore, the manager had a larger margin on which to operate.

The manager of an East Lansing cafeteria stated that they had some difficulty when clarified cider was first offered. Patrons often picked up a glass thinking it iced tea, even though it was properly labeled. This sidelight speaks well for the appearance of the product.

At a large Lansing grocery store, the ratio of sales was five gallons of the clarified cider to one of the ordinary when displayed side by side at a price differential of ten cents per gallon. A survey of Jackson stores indicated that several grocers that now do not handle cider would carry the clarified cider if available.

A fruit grower at Romeo, Michigan, installed a filter this season and reports that 75 per cent of his sales have been filtered cider which retailed at 50 cents per gallon, including the glass jug, while the unfiltered was offered at 25 cents per gallon net making a price differential of about 14 cents. He experienced difficulty, however, in filtering. How much the enzyme treatment will remedy this difficulty remains to be seen, though tests at the college showed the clarified cider to filter very much more readily than untreated lots. Another grower near Cincinnati, Ohio, reports sales of 1,000 gallons of filtered cider per week at 40 cents and 30 cents net for retail and wholesale lots, respectively. His neighbors offered ordinary cider at 20 cents but had little business.

Method of Clarification

Pectinol, like other enzymic preparations, requires time to complete its work or to complete the chemical reaction in the cider. If four pints will do a certain amount of work in four hours, eight pints will do the same work in two hours, or two pints will do the same work in eight

hours. The rate at which the reaction proceeds also depends on temperature. If four pints will complete the reaction in four hours at 70° F., two pints should do the same work in the same time at 100° F., or eight pints at 50° F. The amount to use must also be varied slightly with the varieties and the degree of ripeness of the fruits.

Though specific recommendations of amounts of pectinol to use under varying conditions cannot be given, the practice followed at Michigan State College, together with changes that would be made for variations in time and temperature, may serve as a guide.

Some of the apples from which the cider is made come from cold storage. The juice is generally expressed during the afternoon and goes into the barrels at a temperature varying from 50 to 60 degrees. About 20 ounces of pectinol are added to each 50 gallon barrel immediately after expression. The barrel is then moved into cold stor-

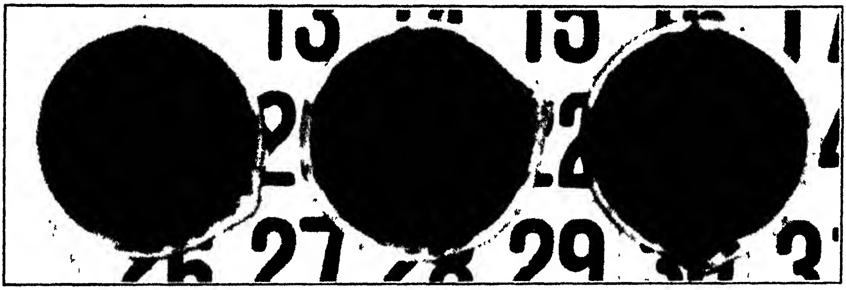

Fig. 2.—Looking down through three beakers filled with cider and these three samples of cider came from the same original barrel. Sample A on the left was allowed to settle about 20 hours and was then siphoned off Sample B in the center was subjected to enzymic clarification for about 20 hours and was then siphoned off. Though slightly turbid it would be regarded as a very satisfactory product. Sample C on the right was clarified, but not siphoned off, and filtered It may be characterized as a polished or brilliant reddish amber juice with the sparkle of champagne.

age until the following forenoon, when it is filtered. This usually means that the pectinol has 14 to 16 hours in which to work. On this basis, it would appear that one pint of pectinol should be sufficient for over night clarification of a barrel of cider held at 70 degrees where filtering is to follow. Where the cider is made in the forenoon and filtered in the afternoon with about four hours lapse in time, three to four pints of pectinol per 50 gallon barrel would likely be necessary at 70 degrees.

Sometime before clarification is complete a conspicuous sediment may be seen in the cider. This sediment soon begins to settle to the bottom of the container, when the clear liquid may be siphoned off. (Figure 2-B.) Filtration, however, is necessary to recover the juice from the sludge and is essential to the production of a clear sparkling juice such as that shown in Figures 1-B and 2-C.

Filtering the Cider

The plate and frame or the leaf types of filters, in general use in industrial plants, may be used for cider filtration. The filter in use at the College (Figure 3) is designed particularly for fruit juices. Most industrial filters are designed to make use of a "filter aid" which is thoroughly mixed with the liquid. These "filter aids" are usually diatomaceous or infusoral earths of varying porosities which build up porous cakes on a supporting medium through which the fruit juice is forced under pressure. The filter shown in Figure 3 is equipped with a perforated cylinder about six inches in diameter and 24 inches long inside of which is fitted a cloth. The fruit juice containing the "filter aid"

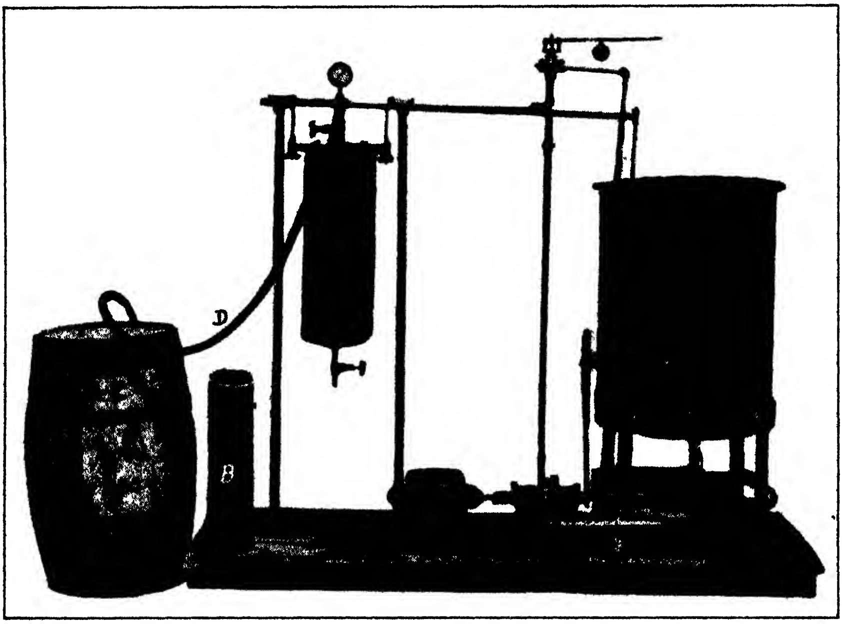

Fig. 3.—A filter designed for fruit juices. The filter aid is thoroughly mixed with the cider in the enameled tank shown at A. The filter core B, consisting of a perforated cylinder lined with a filter cloth to support the filter cake, is enclosed by the enameled container C. The finished product is carried to barrels or other containers through a pipe or hose D. All iron parts should be enameled or tinned.

is pumped from the mixing tank into this cloth lined cylinder where the "filter aid," being unable to pass through the cloth, builds up a porous cake one-half inch or more in thickness through which the juice is forced under pressure. As the juice passes through this porous filter cake the broken down colloidal matter and sediment are collected while the clear juice passes through and runs into barrels or other containers.

The rate of filtration depends on the extent to which clarification by enzymic action has proceeded, the amount of sludge in the juice, the

nature and amounts of filter aid used, and the pressure employed. The filter aid should be one giving a maximum rate of flow consistent with complete clarification. The trade name of the one used in these tests is "hyflo." Though precoating of the filter cloth is often recommended it appears to be unnecessary with the materials and equipment used. Different amounts of "hyflo" were used with different lots of cider and it would appear that satisfactory results will be obtained if two pounds are added to the first 50 gallons of cider and one pound to each additional 50 gallons until about 200 gallons have been filtered, when the filter cloth should be changed. Greater amounts of filter aid should be used with juices from very ripe fruit and those containing large amounts of sludge.

Faster and more satisfactory filtration resulted from operations at low pressures than at high ones at the beginning of the run. The operator of this particular filter tries to maintain a pressure of four to five pounds while the first filter aid is being deposited on the filter cloth and then allows the pressure to rise to about 10 to 20 pounds for the balance of the run, though the latter part of a 200 gallon run may have to be at still higher pressures.

Handling Cider

The number of days that cider may be kept sweet without pasteurization or the use of a preservative depends on the temperature at which it is held and whether the containers are thoroughly sterilized. If cold storage facilities are available, the cider may be kept sweet for several weeks at temperatures at or below the freezing point. Where there are no cold storage facilities, the cider must be kept in the coldest locations available and, unless pasteurized or preserved, plans should be made to produce it frequently, keeping only enough on hand to take care of anticipated day to day demands. The barrels or other containers in which it is held should be scalded frequently to kill bacteria that further fermentation.

Cider may be preserved by adding five to seven ounces of benzoate of soda to each 50 gallon barrel but the pure food laws require that such be stated on the label. The public does not like to use goods so preserved which means that such a practice cannot be recommended.

Incidentally, it may be stated that clarified and filtered cider keeps sweet somewhat longer than untreated cider because fermentation is retarded by the mechanical removal of some of the microorganisms. This effect, however, may be partially counter balanced by the length of time required to complete the clarification and subsequent filtration.

Production Costs and Returns

Costs of clarifying and filtering cider depend on the amount of cider produced per season, the kind and cost of the equipment, and the time and temperature factors involved in clarification. Assuming that 100 barrels of cider are clarified per season with the materials, equipment, and methods described in this paper, and allowing the usual charge for labor and interest and 20 per cent for depreciation on the equipment, the cost per gallon of filtering cider is slightly less than five cents.

The usual charge for grinding the apples and expressing the juice is three cents per gallon, though the actual cost will vary with volume.

equipment, and management. The practice at the College is to use five or six varieties in making each lot of cider. The average yield is about three and one-half gallons of cider per bushel of apples. The cost of converting a bushel of apples into clarified and filtered cider is therefore about 28 cents. At a wholesale rate of 25 cents per gallon for the cider, the gross return for each bushel of apples is approximately 88 cents and the net net return approximately 60 cents, better return than many growers obtained for the better grades in 1931. In seasons when fresh fruit is bringing normal prices, cider sells for five to ten cents more per gallon which means a net return of 15 to 35 cents per bushel greater than for 1931.

BULLETIN REVIEWS

Tech. Bul. 115.—THE DIAGNOSIS OF SPECIES OF FUSARIUM BY THE USE OF GROWTH-INHIBITING SUBSTANCES IN THE CULTURE MEDIUM.—Coons, G. H. and Strong, M. C.—Many species and varieties of Fusarium were found to show differences in color, in breadth of growth, in type of growth, and in ability to change the color of a dye when grown on a synthetic culture medium containing such growth-inhibiting substances as crystal violet, malachite green, brilliant green, acriflavine, and copper sulphate. Methods are described which will aid the laboratory worker in identifying Fusarium species, a group commonly recognized as difficult to determine. Fifty-four species and varieties; represented by 104 cultures, were tested repeatedly by the methods outlined and the results obtained are summarized. It was found by many repetitions of the tests over a period of several years that approximately the same results were obtained each time. A provisional key based on the responses shown in these tests is given. (78 pages, 7 plates, 18 tables.)

Tech. Bul. 119.—VEGETATIVE PROPAGATION OF THE BLACK WALNUT.—Sitton, B. G.—It was found that neither fertilization nor premature defoliation of the trees from which cions were cut, or of the stocks in which the cions were inserted, greatly influenced the percentage that formed unions and grew. However, a larger percentage of the grafts exposed to temperatures between 25° and 30° C. formed callus and united than at temperatures either higher or lower. The optimum temperature seems to be in the neighborhood of 28° C. or 82° F. (45 pages, 21 figures, 20 tables.)

JOURNAL ARTICLE ABSTRACTS

INVESTIGATIONS ON THE BLACK ROOT OF STRAWBERRIES. —Strong, F. C. and Strong M. C.—(Journal Article No. 60 (n. s.) of the Mich. Agr. Exp. Sta.)—Phytopathology. 21(11): 1041-1060. 1931. Black root of strawberries is a disease that is wide spread in Michigan, and is reported from many other states and Canada. The symptoms of the disease are stunting and wilting of the plants, often during the picking season, so that plants die with green fruit hanging on the stems. The roots of diseased plants are black and corky in texture. Young roots show definite, brown lesions that enlarge and may involve the whole root. Many lateral roots are rotted off, which reduces the ability of the plant to obtain water and nutrients from the soil. This condition has been confused with drought and winter injury. Experimental evidence is given to prove that black root is an infectious disease, transmissable from one plant to another. The disease, as found in Michigan, is assigned to two common fungi, *Hainesia lythri* and *Coniothyrium fuckelii* and proof of their pathogenicity is given. Since investigators in other States have found other soil fungi associated with the disease, the authors conclude that black root may be caused by several soil-inhabiting fungi. Attempts at control by means of root treatments with various chemical disinfectants were not successful. The only control measures recommended are cultural practices that will keep the plants in a good growing condition, and a rotation of crops.

SPRAYING TO CONTROL THE CODLING MOTH IN SOUTHWESTERN MICHIGAN.—Sherman, Franklin, III.—Jour. Econ. Entom. 24(5): 1075-1077. 1931. (Journal Article No. 62 (n. s.) from the Michigan Agricultural Experiment Station.)—Spraying experiments in southwestern Michigan indicate that several summer brood sprays of lead arsenate may be necessary to satisfactorily control codling moth. Sprays of oil with nicotine sulphate have good results on an early variety but were less satisfactory on later varieties. In all cases, where oil with nicotine was used in the summer brood sprays, the arsenical residue on the fruit was greatly reduced. Oil sprays, where used alone, for the summer brood larvae were ineffective. Some oils, when used in combination with nicotine sulphate, may cause injury to the fruit.

BREEDING CORN BORER RESISTANT CORN.—Marston, A. R.—Jour. Am. Soc. Agron. 23 (12): 960-964. 1931. (Journal Article No. 64 (n. s.) from the Mich. Agr. Exp. Sta.)—This article reports further results from the testing of Maize Amargo x native Michigan corn varieties for resistance to the European corn borer, Maize Amargo being a late maturing South American corn evidently markedly resistant to borer attack. All strains from crosses in which Maize Amargo was used, had fewer borers per 100 corn plants, a greater number of plats without borers, and decidedly fewer plats with two or more borers present than crosses between Michigan corn varieties inbred for same number of generations. That the late maturing characteristic of Maize

Amargo is not the cause of its resistance to the corn borer is indicated by the fact that other equally late maturing and unadapted varieties when crossed with native Michigan varieties lack resistance and their reaction to borer attack is similar to that of local corn crosses.

ALFALFA SEED PRODUCTION STUDIES IN MICHIGAN.—Down, E. E.—Jour. Am. Soc. Agron. 23 (12): 983-999. 1931. (Journal Article No. 66 (n. s.) from the Mich. Agr. Exp. Sta.)—An experiment was begun in 1928 at the East Lansing Station to study the influence of artificial tripping of the alfalfa flower upon seed production under Michigan conditions. The experiment was enlarged in 1929 to include the influence of such atmospheric factors as temperature, relative humidity, and calculated moisture content upon pod and seed production.

The results obtained showed conclusively that lack of tripping was one of the chief factors limiting alfalfa seed production during 1928-29. In 1928, 45.1 per cent of the flowers artificially tripped produced pods, while 15.8 per cent of those allowed to develop normally set pods. In 1929, 56.1 per cent of the flowers artificially tripped produced pods, while 12.2 per cent of those allowed to develop normally set pods. No marked relationships were found between atmospheric factors and the setting of pods.

INFLUENCE OF ALKALIES ON AVAILABLE CHLORINE AND ON GERMICIDIAL EFFECT OF SODIUM HYPOCHLORITE IN PRESENCE OF ORGANIC MATTER AS ICE CREAM MIX.—Fabian, F. W., Beavens, E. A., Bryan, C. S. and Jensen, J. M.—Jour. Ind. and Engr. Chem. 23: 1169-1182. 1931. (Journal Article No. 67 (n. s.) from the Mich. Agr. Exp. Sta.)—It was found that sodium hypochlorite was comparatively stable for one hour at 50° C. in the absence of organic matter as ice cream mix. Sodium hydroxide and sodium phosphate had a stabilizing influence upon it. Sodium carbonate in small amounts exerted a stabilizing influence upon the sodium hypochlorite but larger amounts tended to decompose it. In the presence of organic matter, as ice cream mix, sodium hypochlorite rapidly lost its available chlorine. When the amount or organic matter was increased, there was not a corresponding quantitative decrease in the amount of available chlorine.

The addition of alkalies to sodium hypochlorite in the presence of ice cream mix increased the loss of available chlorine and was proportional to the amount of alkali added. The influence of the alkalies in the order of their decreasing effect was NaOH, Na_2CO_3 and Na_3PO_4.

Large numbers of bacteria reduced the amount of available chlorine. A comparison of the germicidal effect of NaOCl to which 0.5 per cent of Na_2CO_3, NaOH and Na_3PO_4 had been added showed that, in the presence of ice cream mix: (1) Na_2CO_3 is the least effective: (2) there is a correlation between the amount of available chlorine present and the germicidal effect of the solution; this is especially true with Na_2CO_3; (3) 0.5 per cent NaOH and Na_3PO_4 when added to NaOCl killed the bacteria in practically all cases; (4) the effectiveness of NaOH apparently is due to its pH since experiments showed that it greatly reduced the loss of available chlorine under similar conditions; (5) the addition of 0.5 per cent of Na_3PO_4 to the NaOCl solutions showed it was equally good as NaOH and decidedly better than Na_2CO_3 in killing bacteria.

STUDY OF ANTI-HOG CHOLERA SERUM AND VIRUS FOR THE PRESENCE OF BRUCELLA.—Huddleson, I. F., and Johnson, H. W.—Jour. Am. Vet. Med. Assoc. 79 (n. s. 32): 635-637. 1931. (Journal Article No. 75 (n. s.) from the Michigan Agr. Exp. Sta.)—A search has been made of 31 serial-lot samples of clean anti-hog cholera serum, 43 serial-lot samples of wholeblood serums, and 59 serial-lot samples of hog cholera virus for the presence of viable *Br. suis*. The samples were collected in two seasons of the year, summer and winter, and came from widely distributed manufacturers. In not a single sample of serum or virus could viable *Br. suis*. be detected, either by bacteriological examinations or animal inoculations. Whole-blood samples from 100 hogs on farms in Michigan that reacted to the agglutination test in high titre have been examined for the presence of *Br. suis*. The examination of these samples failed to reveal the presence of the organism.

Although it cannot be said with a certainty that *Br.suis* never occurs naturally in commercial anti-hog cholera serum and virus, the foregoing examinations would strongly indicate that the possibility of its presence in a living state at the time of distribution is *rather* remote.

PASTY EYES IN DUCKLINGS.—Stafseth, H. J.—Jour. Vet. Med. Assoc. 79 (n. s. 32) (5): 638-640. 1931. (Journal Article No. 80 (n. s.) from the Mich. Agr. Exp. Sta.)—A study was made of a disease which during its outbreak in a large duck-raising establishment killed from 75 to 100 ducklings each day. The outstanding characteristics seemed to be watery or even pasty eyes manifested in ducklings dead in the shell and in ducklings just freed from the shell. There seemed also to be evidence of faulty development of the embryo, prominent weakness at time of hatching or soon thereafter, and a prevalent failure of the naval to close properly. Postmortem findings were few. All bacteriological and serological examinations, as well as attempts to transmit the disease were negative. The ration fed to the breeding stock seemed to be low in vitamins A and D. Upon feeding cod liver oil and additional corn, the trouble improved and disappeared after the second week. The negative results of the bacteriological work, the high standard of sanitation maintained in the incubators, and the strikingly gradual and regular improvement following the change in the feed of the breeding stock suggest that this disease might be of nutritional origin, perhaps a vitamin A or D deficiency, rather than of an infectious nature.

The Bulletins of this Station are sent free when available to such individuals as may request them. Address all applications to the Director, Agricultural Experiment Station, East Lansing, Michigan.

LIST OF AVAILABLE BULLETINS

Regular Bulletins—

262 Suggestions on Planting Orchards.
264 Second Report of Grade Dairy Herd.
267 Michigan Weeds (only to Michigan libraries and teachers. Others 25c).
277 Studies in the Cost of Market Milk Production.
281 Beautifying Farm Home Grounds.
284 Some Information and Suggestions Concerning the Use of Phosphorus.
286 Studies and Cost of Milk Production—No. 2.

Special Bulletins—

71 Studies in the Range and Variation of the Per Cent of Butter Fat in the Milk of Individual Cows.
83 Key to Orthoptera of Michigan.
91 Lime for Michigan Soils.
94 The Financial History of a Twelve-Year-Old Peach Orchard.
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110 Special Report of the Upper Peninsula Experiment Station.
111 Studies in City Milk Distribution.
120 The Microscopic Identification and Determination of the Specific Ingredients in Stock Feeds.
123 Second Growth Hardwood Forests.
124 The Colorimetric Hydrogen-ion Determination as a Means of Locating Faulty Methods at City Milk Plants.

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130 The Clovers and Clover Seed Production in Michigan.
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173 The Principal Bulb Pests in Michigan.
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189 The Marketing of Michigan Milk.
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207 Public Health and Educational Services in Michigan.

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61 The Relation of High Cellular Counts to Bacterium Abortus Infection of the Udder.

62 Some Physical and Chemical Properties of Several Soil Profiles.

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65 Studies on a Non-Virulent Living Culture of Bact. Abortus Towards Protective Vaccination of Cattle Against Bovine Infectious Abortus (Bang's Abortion Disease).

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MICHIGAN AGRICULTURAL EXPERIMENT STATION QUARTERLY BULLETIN
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WASHINGTON, THE MASTER FARMER*

During this Washington anniversary year the halo of his military and civil glory has tended to obscure his talents in other lines. The public is commonly reluctant to allow great men the meed of greatness in more than one sphere of action. Many have exhibited their talents in several lines but the sun of glory commonly shines upon but one. Lenardo de Vinci is known for the Mona Lisa and the picture of The Last Supper and but few know that while he was the master of painting he was likewise a great architect and engineer, a musician by habit, a literatist of no mean ability, and, amazing and contradictory as it may seem, he was a leader in science. Similarly, had Washington not acquired so great fame as soldier and as President it is probable that his preeminence as an agriculturist would have established him as the greatest master farmer that America has yet produced.

Washington, as is well known, was an extensive land proprietor. His estate at Mt. Vernon comprised some 8,000 acres of land, about 2,000 of which were under cultivation. Before the Revolution he was one of the most extensive tobacco planters in Virginia. His crops were shipped in his own name to England, on the vessels that came up the Potomac to Mt. Vernon or nearby points. In return he imported, from his agents abroad, improved agricultural implements, clothing, and stores needed in the operation of the estate.

During the Revolution, although he was necessarily absent from the farm, his plans were carried out by frequent and minute directions to his manager there.

After the Revolution he returned to his beloved Mt. Vernon and applied himself diligently to the pressing agricultural problem of improving the mode of farming then in practice in that section of the country. It was manifest that the system of tobacco planters was rapidly exhausting the fertility of the land. By correspondence with some of the most distinguished agricultural scientists of Great Britain, by study of the best treatises available abroad upon the subject, he immediately brought into practice the most valuable principles which he could draw from the soundest theory and practice then known. Thus, at this time when the planters of Virginia were considering the necessity of abandoning their worn out soils and migrating to new lands of the west, Washington began a new and, as later proved, an excellent system of crop rotation by growing grains, grass, and root crops in rotation with tobacco. By this means, he soon restored the fertility of his acres, and found his income materially increased while his neighbors, still practicing the old system, were annually harvesting smaller crops and becoming poorer.

One of the habits that contributed greatly to his success in all that he

*This article, based on one written in 1848 by Andrew Jackson Downing, was prepared by C. P. Halligan, Section of Landscape Architecture.

undertook was the complete manner in which he first mastered his subject and the exactness with which he afterwards marked out his work and pursued his plans. For his farming operations, he had a map upon which every field of the estate was numbered. Supplementing this map he kept an agricultural field-book, in which crops were assigned to each field for several years in advance. He had studied the nature of the soils so carefully that, with but slight deviations, this scientific system of crop rotations was followed successfully from 1785 to the close of his life.

Washington's residence exhibited every mark of the cultivated and refined taste of its proprietor. It stood in the midst of the rich landscape beauty of the Potomac, with its beautiful lawns extending to the river, its serpentine shrubbery-bordered walks, its fruit and flower gardens so effectively laid out and planted largely by its master with his own hand. His diary shows that he collected and planted a variety of rare trees and shrubs and watched their growth with the greatest interest.

After about four years, doubtless the most agreeable of his whole life, of improving the conditions of his estate, he was again called by his country, this time to serve as its first President. Those who have taken root in the soil as he had will appreciate how hard it must have been for Washington, the Farmer, again to relinquish the life he so much loved even for the flattering wish of the whole nation, for what he realized would prove a most difficult public service. Washington was so thoroughly devoted by taste to agriculture, that instead of leaving the operation of his estate to the efficient care of his manager whom he had so well trained in his own system of practice, he left full and minute directions, in writing, of the work to be accomplished and he received a weekly report from the manager. In this was recorded "the number of laborers employed, their health or sickness, the kind and quantity of work executed, the progress in planting, sowing or harvesting the fields, the appearance of the crops at various stages of their growth, the effects of the weather on them, and the condition of the horses, cattle and other livestock."

Thus, he was able to keep fully informed as to all that was done and could give his orders with almost as much precision as if he had been on the place. "At least once a week and sometimes twice he wrote to the manager, remarking on his report of the preceding week and giving new directions. These letters frequently extended to two or three sheets and were always written with his own hand. Such was his laborious exactness, that the letter he sent away was usually transcribed from a rough draft, and a press copy was taken of the transcript, which was carefully filed away with the manager's report, for his future inspection. In this habit, he preserved with unabated diligence, through the whole eight years of his Presidency, except during the short visits he occasionally made to Mt. Vernon, at the close of the sessions of Congress, when his presence could be spared at the seat of government. He, moreover, maintained a large correspondence on agriculture with gentlemen in Europe and America. His letters to Sir John Sinclair, Arthur Young and Dr. Anderson, have been published and are well known. Indeed his thoughts never seemed to flow more freely, or his pen move more easily, than when he was writing on Agriculture, extoling it as a most attractive pursuit, and describing the pleasure derived from it, and its superior claims, not only on the practical economist, but on the statesman and philanthropist."

Thus is revealed a most interesting and little known portion of Wash-

ington's life and character. Here his personal tastes were more particularly gratified and he is found no less successful as a farmer than in his wonderfully great life as a soldier and a President.

Beyond the splendidly inspiring picture of the rational enjoyments of country life presented by Washington, his agricultural efforts are very significant from the more critical point of view of the agricultural historian. Though diminishing yields on land long cropped had been noticed for many years and though he realized, perhaps more than any man of his time, the potentialities of the then unsettled country west of the Alleghenies, Washington was the first American to undertake, in a systematic, comprehensive manner, the maintenance of soil fertility in the areas already settled. It was inevitable that for many years the predominant agricultural phenomenon in America was to be the opening of new lands, and the adjustment of crops to them, and the full significance of Washington's efforts was hardly to be appreciated during this time. In the older sections, however, his efforts, reinforced by his prestige in other fields, did attract attention and the early success of the efforts of the various societies for promotion of agriculture must have been due in no small measure to his example. Sooner or later, the questions Washington faced on his Virginia farm have confronted every section and become fundamental to them. They are inevitable. His implied sense of the landowner's moral responsibility to maintain the fertility of his soil, to leave his land better than it was when he became its steward, is basic to national welfare. It should, therefore, be remembered that Washington was not only first among those who established our country, but he was also first among those who moved toward giving it a permanent agriculture.

SAVING SURFACE SOIL AND PREVENTING EROSION

L. R. TAFT, SECTION OF HORTICULTURE

Note—Erosion of the soil has come to be one of the most important problems in many Michigan orchards—important first because it results in impoverishment of soil and trees and second because it takes place in considerable part without the grower's realization and consequently without his taking steps to deal with it. Mr. L. R. Taft, the author of this article and formerly Horticulturist at the Michigan Experiment Station, has for a number of years been successfully solving this problem in a large commercial orchard in northern Michigan. His article is most timely.

V. R. Gardner.

The importance of erosion in the orchard, as manifested in the formation of gullies, scarcely needs emphasis. Less obvious, but fully as important, and much more common, is the type known as sheet erosion. When the main roots of trees are laid bare, erosion has occurred, though no gullies are formed. This type of erosion removes the surface soil, the best for trees as well as for crops, and leaves the subsoils, lower in humus and in fertility, to be contended with by the tree and the fruit grower. Furthermore, the loss of surface soil is adverse to the growth of cover crops, which thus become poorer as the need for them increases. The more cultivation an orchard receives,

the more subject it is to these losses. Since cultivation is an annual practice in orchards, erosion losses are greater there than with the usual farm rotations. When orchard follows orchard on a piece of land, as frequently happens, the cumulative effects are bound to be great. The exposed roots of peach and cherry trees bear witness to the amount which can occur in a few years.

Part of this erosion is due to wind action, part to run-off of rain and melted snow. In general, wind action is greater on upper portions of slopes, while water action predominates on the lower portions, in proportion to the water running down from the upper portions. Real control of erosion, therefore, begins at points above those where gullies appear, in the control of the countless small inconspicuous rills whose aggregate produces the gouging that is manifest. Checking either form helps in checking the other. Wind erosion may be checked by sod, mulch, or cover crops in exposed spots and solutions of the problems it presents are in general fairly obvious. Control of water erosion is likely to fail or to involve inordinate labor and expense unless it is done correctly. The expedients presented here are the results of some years of trial in a commercial orchard.

Erosion in Orchards

For generations it has been customary to plant orchards on hillsides. For various reasons this plan has much merit, but, when the orchard is to be cultivated as is desirable for cherry, plum, and peach orchards, and as is the practice in many of the better apple orchards, serious erosion often results. If the slope is comparatively steep, it will generally be advisable to keep the orchard in sod, cutting the grass and using it about the trees while they are small and allowing it to remain where it falls when the trees get older and the roots spread out. The growth of the grass may be stimulated by using manure or fertilizer, and the two crops that can be grown in a year will not only be very effective as a mulch for the trees but will hinder the run-off of the rainfall and the washing of the soil.

As a substitute when a permanent sod mulch is not desired, the plowing and dragging of alternate strips in the orchard will often be helpful since, by alternating the strips from year to year, a combination of a sod mulch and of cultivation with a cover crop can be secured. While the trees are young, the cultivated strips may be formed by back-furrowing against the rows of trees leaving the sod remaining to be clipped. Later on, the tree rows can be kept in mulch and the strips between the rows can alternately be kept in sod and cultivated. The unplowed strips will serve a good purpose in preventing erosion and in keeping up the humus, which of itself helps to prevent erosion.

Terracing Orchard Land

On steep slopes that are to be used for orchards, it is often possible to make permanent terraces before the trees are planted. If the slope is an even one, the terraces may be in straight lines, at the proper intervals to allow the planting of a row of trees on each terrace (Fig. 1). In cases where the contour lines run in curves, the terraces may be run around the hill practically at a grade level. If to be made in this way, the terraces on steep slopes should be from 10 to 16 feet wide. Ordinarily, there would be a terrace for each row of trees.

Furrowing to Prevent Erosion

Even when the slope is no more than three to five feet in 100 feet, serious erosion may occur in cultivated orchards during cloud bursts or even in heavy rains. It may not be worth while to throw up permanent terraces but it will pay well to make use of furrows to prevent erosion and check the run-off of the rainwater. Furrows used in this way may be considered as temporary terraces.

Instead of back-furrowing to form a wide terrace, one or, at most, two furrows are turned down the slope and used to prevent the running off of the water. This alone may serve or it may be desirable to use a shovel to open up the furrow on elevations and to build up the furrow slice or ridge

Fig. 1.—Terraces in a cherry orchard. A fairly even slope in one direction makes it possible to use parallel and nearly straight terraces or furrows.

where there is a depression. Sometimes a grader or ditching machine may be used to advantage to widen the furrow and increase its water-holding capacity. If some form of road grader is not available, an inexpensive plank scraper can be made like an ordinary snow-plow except that one wing is about one-half longer than the other. The short arm should be shod with a steel plate to prevent wear and make it more effectual as a scraper.

Care should be taken in locating the furrows to have them perpendicular to the natural flow (Fig. 2) as, otherwise, furrows may increase the run-off, thus helping to rob the land of its rainfall, as well as increase the erosion. The distance between the furrows will depend on the amount of slope but it seldom need be less than 20 feet which is the usual distance between cherry, peach and plum trees, while 35 to 40 feet will answer well on gentler slopes where erosion is less but enough to make furrowing worth while.

It often happens that, although the general slope is in one direction, to

the south for instance, there will be an occasional depression or small gully running with the slope, which means that although the general movement of the water is to the south, there will also be slopes to the east and west, and the water on these slopes will run into the gully. Before it has passed beyond the south edge of the orchard tract serious erosion may have been caused in the gully which has carried all of the water from both slopes (Fig. 3). This erosion can be largely prevented by the proper use of furrows, but unless care is taken they will do more harm than good. Furrows run east and west where they will be parallel to the slope will be helpful as they will serve as reservoirs to catch the water and give it opportunity to sink into the soil, instead of rushing down the slope. This both retains the water for

Fig. 2.—Looking south in an orchard where, although the main slope is to the east, the land also slopes to the north. So long as the slope is to the east, a straight terrace running north and south can be used but, where the slope to the north begins, the furrow should swing to the west, at right angles to the slope.

the crop and prevents soil erosion. In case the water continues straight down the hill (Fig. 3 M) it will not only carry more water into the gully than would have gone there had there been no furrow, but the flow will be much more rapid and erosion both in the gully and on the hillside will be increased. This indicates that straight furrows should not be run unless the slope is uniform and at right angles to the furrows.

If the conditions are such that, with a rainfall of one inch in an hour, the water will make its way down the hill without erosion, most of it soaking in on the way, there will be no occasion for terracing, or furrowing, so far as the main slope is concerned, although short furrows to protect small areas may be helpful (Fig. 4). These, of course, should be as nearly level as possible and if they have any slope at all it should be away from the natural flow of the water.

In orchards where the slope curves around a hill, the furrows may be straight until they reach the point where the slope to the side begins and from there they can be run in a curve and practically level, except with a slight slope away from the gully (Fig. 3 I). Instead of having the furrows continuous, as H-I, they may be broken, with the ends overlapping, so that the lower furrows will catch the water from the others (Fig. 3 G-K).

If it is not possible to run the furrows between the main rows of trees, they may be run between some of the diagonal rows (Fig. 5). In case it

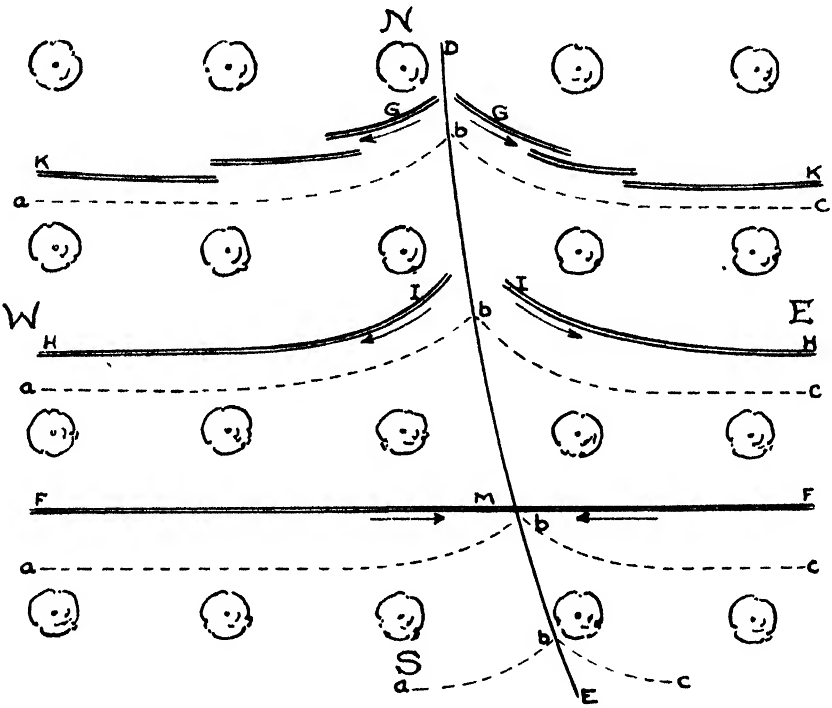

Fig. 3.—Terracing the sides of a gully through an orchard. a-b; b-c, contour lines. D-E general course of gully. F-M, straight furrow or terrace across gully. Seldom if ever desirable. H-I, furrow following the contour, but carrying the water away from the gully. Very good. G-K, broken furrows, similar to H-I, except that the water current is broken. The idea is of general application.

is found after a furrow has been run that it has been given too much of a slope, this can be remedied by damming the flow of water in the furrow and running out a diagonal furrow on the uphill side, to carry off the water which would either rush down the furrow, or perhaps break through the furrow wall and flow down the slope.

These intercepting and overlapping furrows can be made almost as quickly as continuous furrows and unless unusual pains are taken in grading the latter, will be better adapted to act as reservoirs and prevent washing.

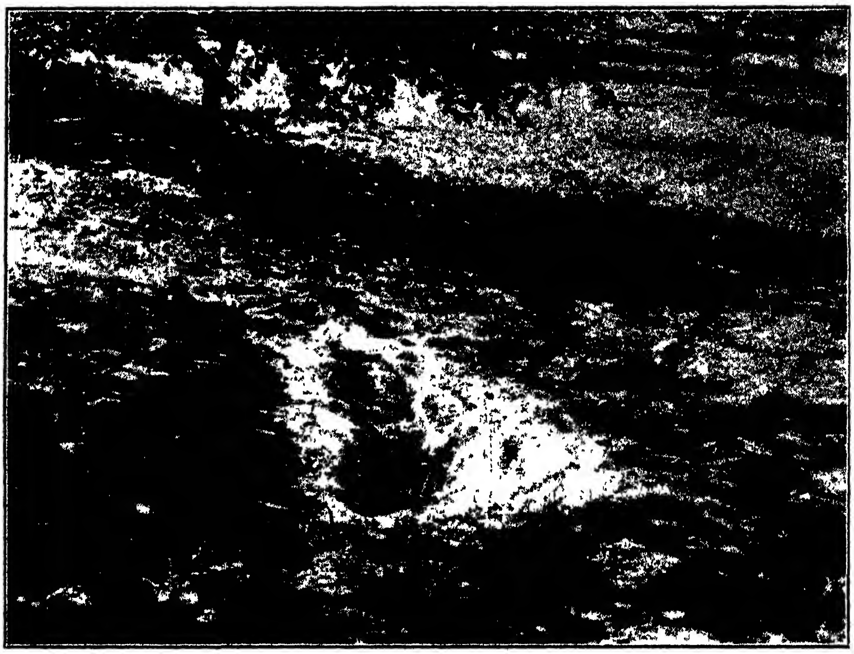

Fig. 4.—When erosion has barely started it can be stopped temporarily by means of a cross furrow which will check the flow of the water and turn the current away from the gully.

Fig. 5.—A curved furrow following the contour line, running at first between the main rows and then turning with the contour line and running between diagonal rows.

Checking up the Furrows

Unless the land has been carefully surveyed, it is not uncommon to find, after the furrows have been made and have been tested in a heavy rain, that the slope is greater than was supposed or that the rainfall is greater than was expected. It is possible to hold back the water by deepening the furrows and use this earth to build up the retaining wall. Dams across the furrows and level diagonal furrows will help to retain the water. During the rain, it will be possible to determine where the furrowing is at fault and make minor changes, at the same time deciding what more is needed. Serious erosion can often be prevented by being on the spot during the first heavy rains after the furrows have been made.

In cultivated orchards nothing is more favorable to erosion than plowing and dragging up and down the slope, as this will provide miniature water courses which in the loose soil will quickly deepen in the next heavy rain. The ruts made by spray rigs and by driving through the orchard act in the same way. So far as possible, the spraying and cultivating of the orchard should be crosswise of the slope.

Repairing Washouts and Gullies

Serious erosion often occurs before it is noticed, or the loss it may cause is fully appreciated. If taken in time, the injury may be readily repaired and further injury prevented. Plowing and scraping to level the soil will often put things in a fairly good condition. Stones are useful in filling gullies. If they are small they should be alternated with layers of soil, clay being preferable for this purpose, while if large stones are used they should be several inches apart and soil should be packed between them. Unless this is done water will find its way between the stones and undermine them. Prunings or other brush may be used in much the same way.

To prevent further washing and gullying, furrows may be made along the sides of the gullies and terraces may be constructed across them to act as dams.

Sometimes it is desirable to place a line of drain tile at the bottom of the gully, 1½ to 2 feet under ground. At the lower end, a spillway with an apron and wings large enough to prevent undermining should be constructed. If convenient, the tile may be covered with gravel and a layer of straw will aid in preventing the entrance of silt and the washing out of the tile in cloudbursts when the tile may prove too small.

The Use of Dams

When a gully has a steep slope, dams may be used to hold back the rush of the water and prevent erosion, at the same time helping to fill the gully. These dams may be either of earth or concrete. If of earth, the middle of the gutter should be higher than the ends, as otherwise the dam might be washed out in freshets. The surplus water should be carried to the sides where it should be turned into trenches running out on a level from the ends of the dam. By thus holding back the water, the silt which it contains will settle and gradually fill the gully above the dam. If the dams are close together the gully will gradually disappear.

Concrete dams should be so constructed that they will not be undermined or washed out at the ends (Fig. 6). There should be a spillway at the center and wings should be constructed on both ends running back from the

dam into the banks. A substantial apron should also be built below the dam to catch the water when it comes over the spillway. It should extend out far enough to prevent under-mining. If there is a drain tile at the bottom of the gully, it may continue down the slope under the dam, or it may be brought out through the wall of the dam just above the apron. Dams of earth may be alternated with the concrete dams and this will aid in filling the gully.

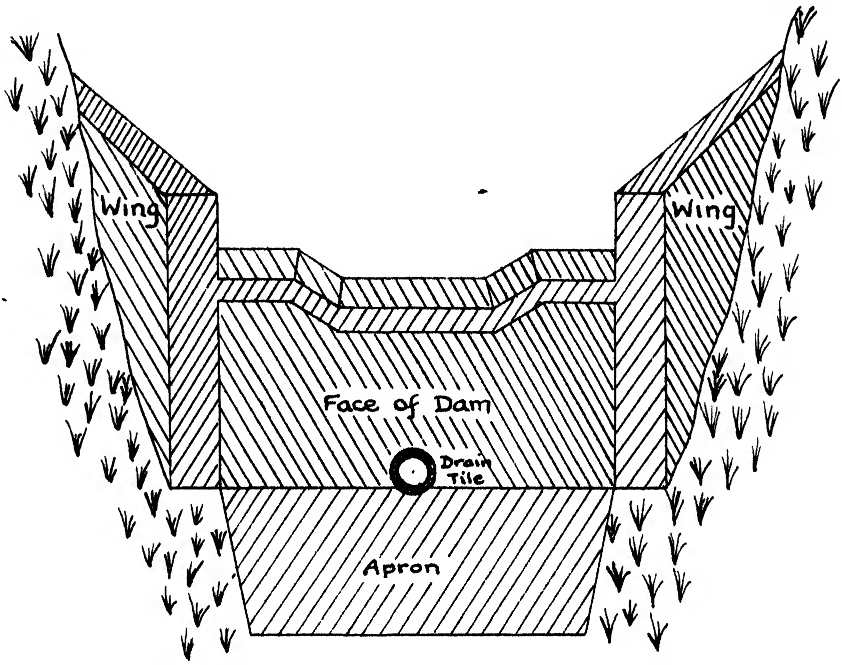

Fig. 6.—Concrete dam across gully, with spillway, wings, apron and drain tile.

STERILIZATION OF DAIRY EQUIPMENT

W. L. MALLMANN, DEPARTMENT OF BACTERIOLOGY

Dairy equipment is sterilized either by hot water or steam and chemical disinfection, preferably with chlorine preparations. In the absence of steam or hot water and in other cases for the sake of convenience, the latter treatment is used. In such treatment it is essential that the chlorine solution used should have sufficient concentration to effect sterilization. For general dairy equipment disinfection, a concentration of 35 to 50 p.p.m. (parts per a million) of solution is recommended. Chlorine concentrations of 0.2 to 1 p.p.m. in the absence of organic matter will kill bacteria nearly instan-

taneously. Such amounts are used effectively in the treatment of municipal water supplies. In the presence of organic matter, however, chlorine in small amounts has practically no value. Due to the extremely active chemical affinity of chlorine for organic matter, the chlorine may be used up entirely and many of the bacteria may be left uninjured. Disinfection may be effected in solutions having a high organic content by adding sufficient chlorine to allow for the chlorine demand of the organic matter and the bacteria.

For purposes of economy, it is the practice, at least of the small dairies, to save this rinse solution for future use. Usually before using again, the solution is tested for residual chlorine content and if the amount present is less than 50 p.p.m. enough additional chlorine is added to compensate for the deficiency. Granting that the chlorine thus determined is active chemically, such practices would be perfectly satisfactory, but recent tests by the writer indicate that chemical activity is lacking and that results are not satisfactory. In a series of tests, such solutions were tested chemically and bacteriologically. The data obtained showed that although the solutions contained sufficient available chlorine as measured chemically still they were unable to destroy the bacteria present. The results show clearly that the residual chlorine found in a solution containing milk in which the chlorine was initially high is not comparable in activity to the same strength of chlorine in a solution in which milk is absent. The data clearly indicate that the residual chlorine content of a chlorine solution containing milk as measured chemically is not a true index of the germicidal chlorine present. Thus any measurements of the so-called available chlorine in chlorine solutions containing milk are inaccurate and give results much higher than the actual germicidal chlorine present. For effective sterilization of dairy equipment by the use of chlorine sterilizers or cleaners, the need of fresh clean solutions is essential. The practice of carrying over old solutions and adding fresh chlorine to make up losses through the action of organic matter present may result in ineffective sterilization.

(A complete report of this work will be published elsewhere.)

TOMATO WORM

Protoparce sexta

E. I. MC DANIEL, SECTION OF ENTOMOLOGY

This large green "worm" was far more than ordinarily plentiful in Michigan during the summer of 1931. It works not only on tomato but also on potato, devouring the tops of both plants very freely. Enormous numbers of these large green "worms" developed in potato fields and in tomato fields in the southwestern part of the state, and to a lesser degree wherever tomatoes and potatoes were grown commercially. These large worms, when full-grown, descend into the ground and make peculiar jug-handled pupae in cells several inches beneath the surface of the soil. There they go through the winter and the following spring each pupa produces a moth, sometimes known as a humming-bird moth, which flies around at dusk and sips nectar from flowers, closely resembling a humming-bird in its motions, although

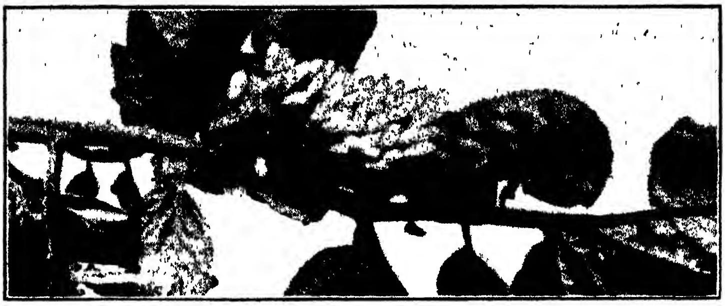

Fig. 1.—Parasites on tomato worm.

it is easily distinguished from the latter because it works at dusk and during the night time. After a short period of flight, the moths lay their eggs on tomato and potato and produce the larvae known as tomato worms.

This insect has some natural enemies, several of which feed on the larvae, but one in particular that is notable because of the peculiar method of attack. This is a tiny, parasitic wasp-like creature that lays its eggs in the body of the living worm, sometimes to the number of several hundred in a single worm. The egg is thrust through the skin by means of a tiny ovipositor, or hollow needle-like arrangement, possessed by the parasite. The eggs in due time hatch into little grubs in the body of the living worm and finally later in the season come to the surface and spin cocoons, shown in the picture. The cocoons appear as small white objects, considerably smaller than a kernel of wheat and loosely attached to the body of the worm. In due time each cocoon gives forth a little, wasp-like parasite, similar to the one that laid the egg in the beginning, and this parasite lays other eggs in other worms to keep the life-cycle going.

Control Measures—After the larvae of the tomato worms attain any size—that is, after they get to be more than an inch and a half long—the only method of control is by hand-picking. Both tomatoes and potatoes are customarily sprayed with Bordeaux mixture in order to prevent blight. The addition of a little arsenical to the Bordeaux mixture, about two and one-half pounds to 100 gallons of Bordeaux, will take care of the worms very nicely. It should be applied fairly early in the season, before the worms reach any size and before they become conspicuous, also when the tomatoes are still small.

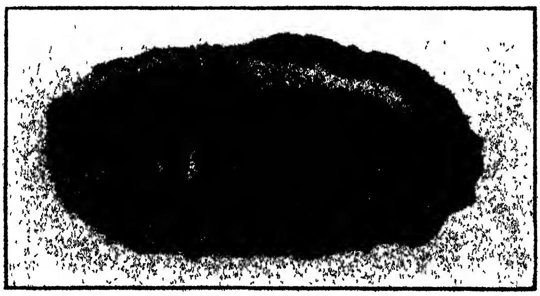

Fig. 2.—Pupa of tomato worm in earthen cell.

SELECTING THE PUMP, POWER AND PIPING FOR IRRIGATION PURPOSES

O. E. ROBEY, AGRICULTURAL ENGINEERING SECTION

Before attempting to select pumping and other equipment for any specific irrigation enterprise—indeed before deciding on the enterprise—it is desirable that there be assembled detailed information as to (1) the nature of the water supply, (2) the area to be irrigated, (3) the crops that are to be grown, (4) the maximum amount of water that is likely to be required within a short period, (5) the height to which the water must be lifted or the pressure that must be maintained and (6) the distance that it must be carried.

Large quantities of water are required to irrigate properly even rather small areas. For instance it takes 27,154 gallons to cover an acre one inch deep with water. Seldom is it desirable to apply less than that amount and often heavier applications are desirable. Furthermore, the available supply and the facilities should be such that this amount can be applied within a 10-hour period, so that there will not be undue loss from evaporation. With some crops, such as strawberries, weekly or even more frequent applications are desirable. This would call for a pump and other equipment having a 3,000-gallon per hour capacity. If it is desired to cover a larger acreage per day or the same area within a shorter period the pump and other equipment must have correspondingly greater capacity. Data showing the pump capacities required for different areas and with operating periods ranging from 1 to 10 hours per day are given in Table 1.

Table 1.—Size of pump required for applying one inch of irrigation water on various areas.

Size of Area in Acres	Rate of Application - Hours									
	1	2	3	4	5	6	7	8	9	10
	Gallons per Minute									
.1	50	25	16.6	12.5	10	8 3	7 1	6 2	5 5	5
2	100	50	33 3	25.	20	16 6	14 2	12 5	11	10
3	150	75	50.	37 5	30	25.	21 4	18 7	16 6	15
4	200	100	66 6	50	40	33 3	28 5	25	22	20
5	250	125	83.3	62 5	50	41.6	35 7	31	27 7	25
.6	300	150	100.	75	60	50	42 8	37 5	33 3	30
7	350	175	116 6	87 5	70	58 3	50	43 7	38 8	35
8	400	200	133 3	100 0	80	66 6	57	50	44 4	40
9	450	225	150	112 5	90	75.	64.	56.	50.	45
1	500	250	166	125.	100	83.	71	62.	55.	50
2	1000	500	333	250	200	166	142	125	110	100
3	1500	750	500	375	300	250	214	187.	166.	150
4	2000	1000	666	500	400	333	285	250	220.	200
5	2500	1250	833.	625	500	416	357	310	277	250
6	3000	1500	1000.	750	600	500	428.	375	333.	300
7	3500	1750	1166.	875	700	583	500	437.	388	350
8	4000	2000	1333	1000	800	666	570	500	444	400
9	4500	2250	1500.	1125	900	750	640	560	500	450
10	5000	2500	1660	1250	1000	830	710.	620	550	500

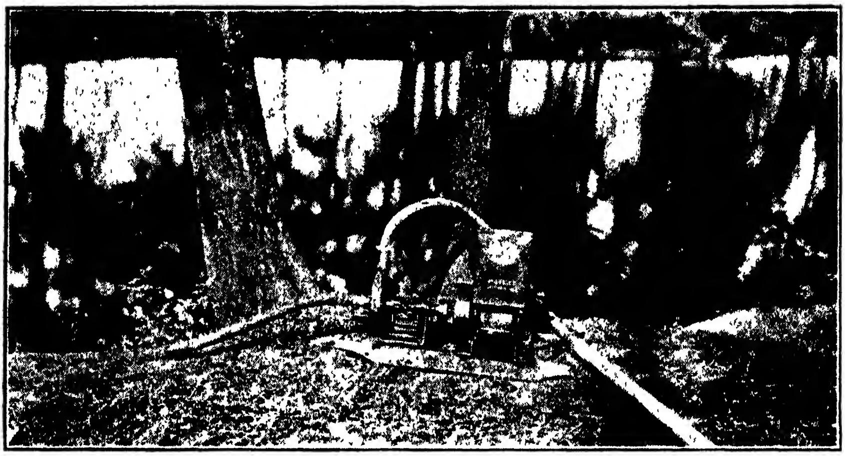

Fig. 1.—Gasoline engine operated centrifugal pump.

Pumps—Water for irrigation purposes may be pumped from lakes, streams or wells. In the case of shallow wells of rather limited capacity two or more may be connected and operated with one pump. Several types of pumps are commonly used: turbine, rotary, centrifugal and piston.

Piston or plunger pumps—the ordinary hand pump belongs in this class—are built for either (1) deep or (2) shallow wells and the one or the other kind should be obtained, depending on conditions. If the water level stands at more than 25 feet below the surface a deep well pump is necessary. The plunger pump is capable of pumping against high pressures and, since its action is positive, the pipe line cannot be closed while the pump is running without damaging either the pump or the piping, unless fitted with some sort

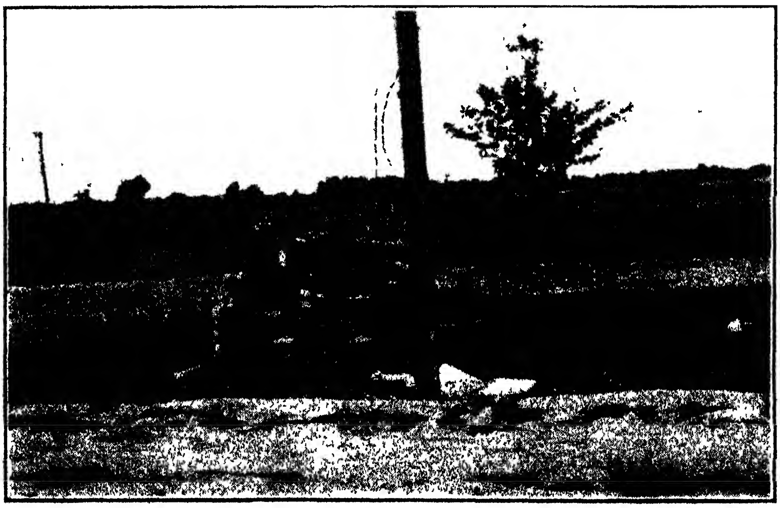

Fig. 2.—Electrically operated piston type, shallow well pump.

of relief valve. This type of pump is suitable only for water that is free from sand and dirt.

The centrifugal pump consists of a revolving impeller in a metal housing. The water is thrown off this impeller by centrifugal force which produces a small amount of suction below the impeller and sufficient pressure above to drive the water through the pipes. Since it has very little suction, it

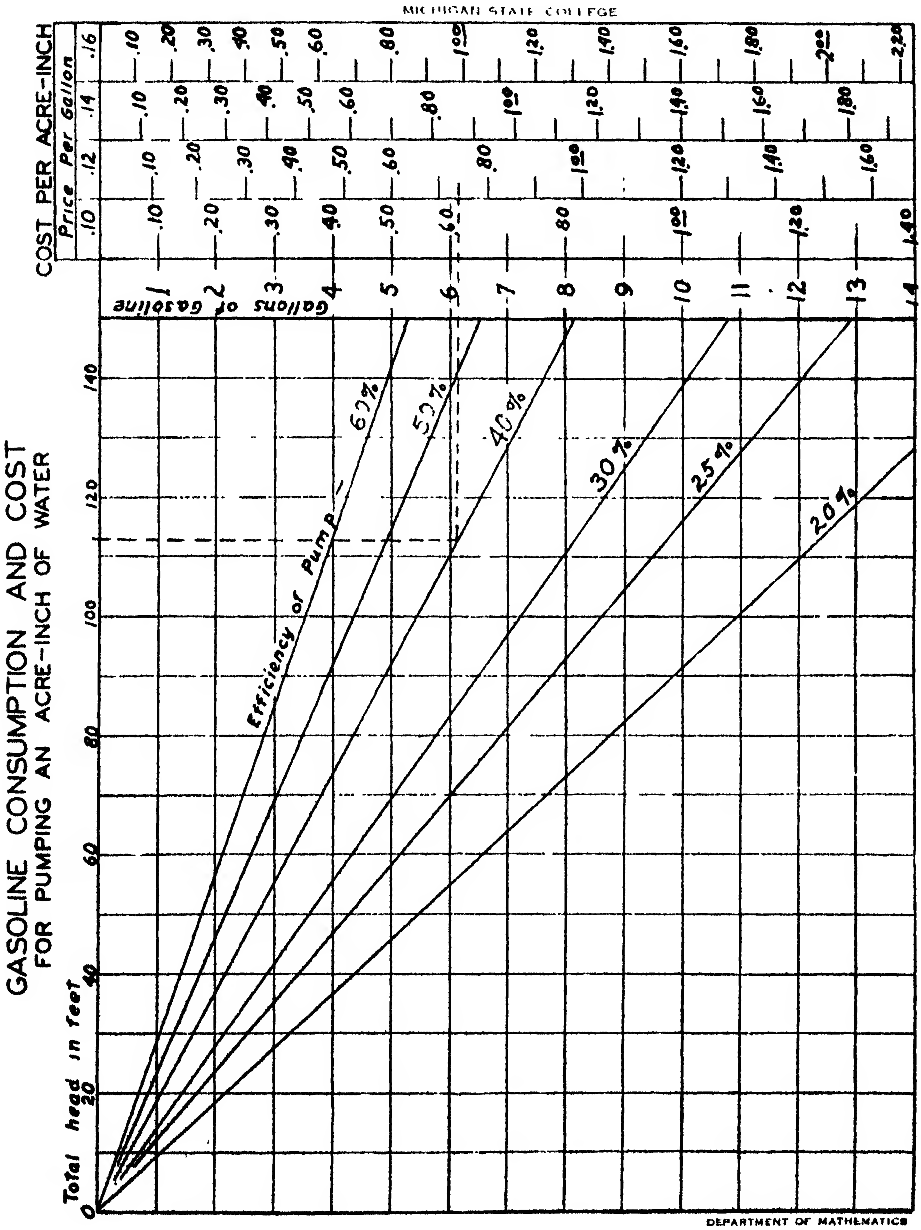

Table 2.—Recommended pipe sizes for ordinary installations.

Gallons per Minute		Length of Pipe in Feet											
		100	200	300	400	500	600	700	800	900	1000	1200	1400
10..........	Size of Pipe	¾"	1"	1"	1"	1¼"	1¼"	1¼"	1¼"	1¼"	1¼"	1¼"	1¼"
	Loss in Feet	30	21	31	41	12½	15	17	19	21½	24	29	33½
15..........	Size of Pipe	1"	1"	1"	1¼"	1¼"	1¼"	1¼"	1¼"	1½"	1½"	1½"	1½"
	Loss in Feet	16	32	48	22	27	33	38	44	20	22	27	31
20..........	Size of Pipe	1"	1¼"	1¼"	1¼"	1¼"	1½"	1½"	1½"	1½"	1½"	1½"	2"
	Loss in Feet	28	9	19	28	38	23	27	30½	34	38	42	14
25..........	Size of Pipe	1¼"	1¼"	1½"	1½"	1½"	1½"	1½"	1½"	2"	2"	2"	2"
	Loss in Feet	15	30	15	20	25	30	35	40	13	14	17	20
30..........	Size of Pipe	1¼"	1¼"	1½"	1½"	1½"	2"	2"	2"	2"	2"	2"	2"
	Loss in Feet	21	42	26	35	43	13	15	17	19	21	25	29
35..........	Size of Pipe	1¼"	1½"	1½"	1½"	2"	2"	2"	2"	2"	2"	2"	2"
	Loss in Feet	29	23	35	46	14	17	19	22	25	28	33	39
40..........	Size of Pipe	1¼"	1½"	1½"	2"	2"	2"	2"	2"	2"	2"	2"	2"
	Loss in Feet	37	30	45	15	18	22	26	30	33	37	44	51
45..........	Size of Pipe	1½"	1½"	2"	2"	2"	2"	2"	2"	2"	2"	2½"	2½"
	Loss in Feet	19	38	14	18	23	28	32	37	41	46	18	21
50..........	Size of Pipe	1½"	1½"	2"	2"	2"	2"	2"	2"	2"	2½"	2½"	2½"
	Loss in Feet	23	46	17	22	28	34	39	45	51	19	22	26
60..........	Size of Pipe	1½"	2"	2"	2"	2"	2"	2½"	2½"	2½"	2½"	2½"	2½"
	Loss in Feet	33	19	27	36	44	53	19	22	24	27	32	38
70..........	Size of Pipe	2"	2"	2"	2"	2"	2½"	2½"	2½"	2½"	2½"	2½"	2½"
	Loss in Feet	11	22	33	44	55	21	24	28	31	35	42	48
80..........	Size of Pipe	2"	2"	2"	2½"	2½"	2½"	2½"	2½"	2½"	2½"	3"	3"
	Loss in Feet	15	29	44	19	23	28	32	37	42	46	25	29
90..........	Size of Pipe	2"	2"	2½"	2½"	2½"	2½"	2½"	2½"	3"	3"	3"	3"
	Loss in Feet	18	36	18	24	30	36	42	48	23	25	31	36
100..........	Size of Pipe	2"	2"	2½"	2½"	2½"	2½"	2½"	3"	3"	3"	3"	3"
	Loss in Feet	22	44	21	28	35	42	49	24	27	30	36	42
125..........	Size of Pipe	2"	2½"	2½"	2½"	3"	3"	3"	3"	3"	3"	3½"	3½"
	Loss in Feet	34	23	34	45	23	27	32	37	41	46	27	31

Table 2.—Continued.

Gallons per Minute		Length of Pipe in Feet											
		100	200	300	400	500	600	700	800	900	1000	1200	1400
150	Size of Pipe	2½"	2½"	2½"	3"	3"	3"	3"	3"	3½"	3½"	3½"	3½"
	Loss in Feet	16	32	48	26	33	39	46	53	28	31	37	44
175	Size of Pipe	2½"	2½"	3"	3"	3"	3"	3½"	3½"	3½"	3½"	3½"	4"
	Loss in Feet	22	44	27	36	44	53	30	34	38	13	47	30
200	Size of Pipe	2½"	3"	3"	3"	4"	4"	4"	4"	4"	4"	4"	4"
	Loss in Feet	29	23	35	46	14	17	20	23	25	28	31	34
225	Size of Pipe	3"	3"	3"	4"	4"	4"	4"	4"	4"	4"	4"	4"
	Loss in Feet	16	31	48	15	19	33	27	31	35	39	47	54
250	Size of Pipe	3"	3"	3½"	3½"	3½"	3½"	4"	4"	4"	4"	4"	4"
	Loss in Feet	18	36	26	34	43	51	31	35	39	44	52	61

should be set as close to the water as possible—never more than 10 feet above the surface, unless provided with some special priming device. It is especially adapted for pumping gritty or dirty water from lakes or streams. Manufacturers design these pumps for given capacities when operated at certain speeds and they do not operate satisfactorily except under those conditions. Therefore, the manufacturer should be informed as to the capacity and pressure required and the conditions under which the pump must operate if good results are to be obtained. Centrifugal pumps can be designed for high as well as low pressures, but low pressure pumps, suitable for canvas hose irrigation, are much less expensive and on the whole are satisfactory. The fact that the pipe line can be closed with this type of pump while the pump is running without injury to the equipment is sometimes an advantage.

Rotary and turbine pumps are not used so frequently in pumping irrigation water.

Pumps vary in their efficiency, depending on their type, size, construction and working conditions, from 25 per cent in some of the smaller and cheaper models to 75 per cent in some of the larger and better ones.

Piping—When water flows through a pipe line there is more or less resistance and friction loss. This increases with the length of the pipe line and the number of gallons flowing per minute, but decreases as the size of the pipe is increased. This resistance is usually expressed in loss of "head" expressed in feet of height or pounds pressure. For example, to force 30 gallons per minute through 300 feet of 1½-in. pipe laid on the level requires as much power as is needed to lift the same quantity of water 26 feet. The friction loss in this case is equivalent to a 26-foot "head." The smaller sizes of pipe are less costly to install but it costs more to deliver water through them. In Table 2 data are presented showing the loss in feet of "head" for various lengths of pipe of different sizes and with different rates of flow.

Pump Lift—The pump must not only lift the water from its level in the well, stream or lake to the highest point from whence it flows out on the land, but it must overcome the friction incident to flowing through more or less pipe and it must maintain a certain additional pressure. To find what may be termed the "total lift" of the pump, add the feet of "head" that is the equivalent of this pipe line friction to the number of feet the field to be irrigated is higher than the source of water; then add, for canvas hose irrigation, about 30 feet for pressure in the hose. For surface irrigation, 10 instead of 30 feet should be added. For overhead irrigation, 50 to 80 feet should be added, depending on the length of the overhead pipe lines. Thus for, say, a field 30 feet above the source of water and 600 feet away from it the pipe friction loss would be the equivalent of 53 feet of head for a 2-in. pipe delivering 60 gallons per minute (see Table 2). The total "Pump Lift" for this set of conditions would therefore be $30+53+30=113$ ft. for canvas hose irrigation, or $30+53+10=93$ ft. for surface irrigation.

Power—The most common sources of power for pumping are the gasoline engine and the electric motor. Where electricity is available and can be employed without too much additional wiring, the electric motor is very convenient and reliable. A gas engine may be used when the pump must be placed at such a distance from the house that use of an electric motor

would require considerable line construction and where a drop in voltage would occur.

To determine the horsepower required for a given assemblage of equipment, assuming a pump efficiency of 50 per cent, reference may be made to Table 3. Thus for a 50-gallon per minute delivery and with a 50-foot head (determined as indicated under "Pump Lift") 1¼ horsepower would be required; for a 100-gallon per minute delivery and with a 100-foot head 5 horsepower would be required.

Table 3.—Horsepower required for pumping water at 50% pump efficiency.

Gallons per Minute	Total Head in Feet									
	10	20	30	40	50	60	75	100	125	150
10	.05	10	15	.20	25	30	37	50	62	75
15	.08	15	22	.30	.37	44	56	.75	94	1 12
20	.10	.20	.30	40	.50	60	.75	1 00	1 25	1 50
25	.13	.25	.37	50	62	.74	94	1 25	·1 56	1 87
30	.15	.30	.45	.60	75	90	1 12	1 50	1 87	2 25
35	18	35	.52	70	87	1 04	1 31	1 75	2 19	2 62
40	20	40	60	80	1.00	1 20	1 50	2 00	2 50	3 00
45	23	45	.67	90	1 12	1 34	1 69	2 25	2 81	3 37
50	25	.50	75	1 00	1 25	1 50	1 87	2 50	3 12	3 75
60	30	60	90	1 20	1 50	1 80	2 25	3 00	3 75	4 50
75	38	75	1 12	1 50	1 87	2 24	2 81	3 75	4 69	5 62
90	.45	90	1 35	1 80	2 25	2 70	3 37	4 50	5 62	6 75
100	50	1 00	1 50	2 00	2 50	3 00	3 75	5 00	6 25	7.50
125	63	1 25	1 87	2 50	3 12	3 74	4 69	6 25	7 81	9 37
150	75	1 50	2 25	3 00	3 75	4 50	5 62	7 50	9 37	11 25
175	88	1 75	2 62	3 50	4 37	5 24	6 56	8 75	10 94	13 12
200	1 00	2 00	3 00	4 00	5 00	6 00	7 50	10 00	12 50	15 00
250	1 25	2 50	3 75	5 00	6 25	7 50	9 37	12 50	15 72	18 75

Costs Data that will help determine pumping costs under varying conditions are presented in the accompanying Figure. For instance, assuming a pump efficiency of 50 per cent and a total head or pump lift of 113 feet (the example that has just been cited), it will be seen that it requires about 6 gallons of gasoline to furnish power to pump the water for an acre-inch application. At 16 cents per gallon the power cost would be $0.96. This does not, however, include any labor cost or charge for depreciation on equipment.

SOME OBSERVATIONS ON THE 1931 FLUID MILK MARKETING SITUATION IN MICHIGAN

WILBUR O. HEDRICK, SECTION OF ECONOMICS

Note:—This article, which has been prepared by Dr. W. O. Hedrick, a member of the Economics staff of the Experiment Station, is based on material that was collected by the Milk Marketing Commission appointed by Governor Wilber M. Brucker in 1931. This material was used with the permission of the Commission.
V. R. GARDNER,
Director.

Milk is in a class by itself both as a Michigan farm product and as an article of food in our cities and towns. Michigan ranks fifth among the States in the output of dairy products, and milk is first among the sources of cash income for Michigan farmers. There are 841,000 dairy cows on the 141,000 farms of the State. These farms are usually the general farming type with dairying handled as one of the several major enterprises instead of dominating the entire labor schedule of the farmer.

Marketing Outlets for Michigan Milk

There are four important marketing outlets for farm milk. Named in the order of their importance, they are: city milk plants, creameries, milk condenseries, and cheese factories. The last of these groups is dependent upon low-priced milk for the profitable manufacture of its product. The Michigan cheese factories have steadily dwindled in number during the past half century, leaving not more than 47 at the present time and these mostly in sections remote from large centers of population, but the output of cheese from the State has steadily increased during the last decade, showing, for 1929, the amount of 8,619,000 pounds as compared with 4,032,000 pounds in 1920.[2]

The butterfat returns from milk in Michigan have benefited from a steadily growing market for many years except during the immediate past few years. Creameries number at this time 223, with an average combined annual output during the last decade of 66,000,000 pounds of creamery butter, although in 1929 the output was only 63,426,000 pounds.[3] The 1,176 cream stations scattered through the State collect most of the butterfat used by creameries. Butter making is a year-round business and is carried on in all parts of the State. Creameries and cheese factories have been regarded always as projects very suitable for cooperative effort on the part of dairymen, and about 50 of these Michigan agencies are owned and managed cooperatively.

[1]All data furnished by Dairy Division of Michigan Department of Agriculture except that otherwise identified.
[2]U. S. Yearbook of Agriculture, 1931, p. 923.
[3]U. S. Yearbook of Agriculture, 1931, p. 916.

Milk condenseries are more numerous than was formerly the case, and these factories use a grade of milk fairly comparable in quality with city fluid milk. They fail, however, to pay an equally high price because their product is sold under world competitive conditions, and fluid milk also requires more precautions at the farm dairy. As the city milk demand in Michigan has grown, the condenseries have suffered from the rivalry. Their use of milk, however, is very great, the average requirements of some 40 condensing, evaporating, and powdering plants equalling 538,000,000 pounds of milk annually.

Whole or City Milk and Its Marketing Qualities

The cities and towns of the State are the most important marketing outlets for milk, the product being sold here under the name of whole or fluid milk. This sort of milk offers the chief problem of the day in the Michigan milk industry owing to the extra cost which the farmer must expend in its production; owing to the excess in recent years of this high grade milk which, because of its cost, may not be sold to advantage for manufacturing purposes; and owing to the recent demand decline in city markets due to business depression.

Fluid or whole milk is the most valuable product of the farm dairy, and is sold on a local market, the price being determined on the basis of general demand and supply conditions between this local market and the nearby area. City Board of Health rules require the production of a city's milk supply near the city itself, since otherwise the farms of the dairymen would be too distant for inspection. Due to the fact that milk is a necessary food for infants and a leading item of diet to other consumers, the commodity is carefully regulated through city and village health ordinances and the requirements are more exacting for milk than for other foods. These regulations, while adding greatly to the cost of milk and its products, are necessary since few other foods match dairy products as carriers of bacteria and other impurities and in susceptibility to decay, deterioration, and adulterations. Milk expense to the consumer is further enhanced by the speed with which the article must be handled in the city markets, the consumption of milk being normally not more than about 48 hours later than its production.

Milk marketing expense is also affected by the frequent disparities in quantity between country output and city consumption, the latter being fairly uniform in monthly amount while the former is very irregular. This fact compels the selling of milk on a contract basis, as between producer and dealer, since the latter must assure himself of an ample quantity for every day in the year. It also gives rise to the familiar problems of milk surpluses and shortages in the city markets, problems which are among the most troublesome of any within the milk industry.

The cost of a city milk supply is also affected by the fact that country dairying is a business of small-sized units and is spread over a large area of land, which is commonly called the city milk shed. Added supplies of city milk are obtained, as a result, by going further and further into the country, thus increasing the costs of transport. The average rate at the present time for hauling milk from the farm to the Detroit market is 50 cents per hun-

dred weight or a trifle more than a cent per quart.* The bare statement of these marketing characteristics of fluid milk shows at once that the usual methods of setting prices for farm products are unsuitable for milk and, therefore, special and novel devices must be used.

Farmers' Milk Marketing Associations—The Michigan Milk Producers' Association

The Michigan dairymen have sold their milk to nearby cities and towns through cooperative groups of one type or another for a quarter of a century or more. A half score of these farmers' cooperatives at present are milk marketing associations whose members both produce and also retail the fluid to the nearby town or city consumer. Milk is carried by these groups the whole route from farm to city consumer and the entire receipts are taken by the producers' organization. Another type of Michigan farmers' milk cooperatives, nearly a half-dozen in number, acts merely as collective bargaining agencies, devoting themselves to securing for their members the best possible sales bargains with the city milk dealers. One of these, the Michigan Milk Producers' Association, outstrips the others in age, size, and repute to such an extent that seemingly the whole State field is absorbed by its activities.

The farmer membership in this group numbers more than 16,000, and milk is sold to the cities of Muskegon, Grand Rapids, Jackson, Saginaw, Flint, Ann Arbor, and Detroit, the association supplying normally in this latter city 80 to 90 per cent of the milk consumed. The association also guarantees payment for milk to the farmer, watches the milk trucking rates to the cities, conducts a factory for dairy products at Adrian, and performs several minor services. All of these things are done for a fee of two cents per hundredweight for the milk marketed. The levy is deducted by milk dealers from the dairyman's pay check and then paid to the producers' association.

Prices at which milk is sold to city dealers—wholesale prices—are set at conferences between these buyers and the Association at intervals of a month apart, a higher price is set for milk sold by the dealers as bottled milk and a lower price for the surplus milk which goes into by-products. The hundredweight is the unit of sale for farmers' milk, and prices are made in terms of a city-delivered unit of this sort when intended for bottling purposes, or in terms of country receiving station delivery when intended for manufacture into by-products. Members' milk must comply with certain grade tests and regulations.

Regulated Milk Production: The Base and Surplus Plan

Besides selling milk for members, the Producers' Association tries to regulate the production of the fluid as to uniformity of flow from month to month

*This rate is broken up into the motor tank charges for transporting milk from the dealer's receiving station to the city plant, and the charges for collecting milk at the dairyman's farm and hauling it to the receiving station. The former of these charges averages roughly 30 cents, with a minimum rate of 24 cents for stations near the city and a maximum charge of 45 cents for stations more remote. The average charge for country collection of milk is roughly 20 cents. These rate charges are subject to periodic changes, but the figures given above prevailed in the summer of 1931. The present scale of rates were set by Commissioner of Agriculture Powell as the result of hearings upon the subject held in June of 1931, and are a 10 per cent reduction from rates established a few months before.

during the year, using at present for this purpose the "base and surplus" plan. The city dealers of necessity must buy milk steadily throughout the entire year. Contracts to assure an adequate supply are given to the farmers since the latter will not produce a costly, highly perishable product like milk unless a steady market is assured. The city dealer's need for a fairly uniform daily milk supply the year round necessitates the expansion of herds during the natural milk shortage months of late autumn, with the result that the herds produce a large surplus in the spring. Seasonal surpluses may be looked upon as results from Nature's plan of milk production and are hard to remedy, but their evil effects may be lessened by wise production control, and the maintenance of this control is among the chief tasks of the Producers' Association.

The base and surplus plan of leveling down the milk surplusage of certain seasons and of bringing up the shortages of others is a widely used device. Its success depends upon rewarding the dairymen for a large milk output in the fall seasons of shortage and of penalizing him for too large a flow in the time of spring surplus. The reward used is that of granting him each month of the year a market for the same quantity of high-priced milk as that produced by him during the autumn shortage season. This is called the base milk. Milk offered in excess of this amount goes by the name of surplus and a lower price is paid for it by the city dealer; a price equivalent, in fact, to the New York market price for butterfat plus the cost of trucking to the city or receiving station.

The base and surplus plan became effective in the Detroit market in May of 1930, and is the latest of a series of plans for milk selling and production control tried there during a decade and a half. In 1927, the Philadelphia base plan of production control used in the Detroit market for the five previous years, was given up, and a flat rate price plan was adopted with no attempt at output control. The month of June in 1929, two years later, showed the largest milk receipts ever seen in the Detroit market, equaling for the month 18,000 hundredweight per day, with 8,500 hundredweight of this, or nearly half, going into surplus milk, a situation which was typical of the entire year. A better balanced output became now a prime necessity, and as a result the base and surplus plan was developed.

This plan, aside from certain troubles in being properly understood by dairymen and the milk trade, has proven effective. It succeeded markedly, for example, in keeping down spring surpluses. The summer of 1930, in fact, showed a much smaller surplus and more even receipts of milk in the Detroit market than the year before, and, by employing the happy device of adjusting the farmer's basic volume to a diminishing city consumption, the smallest surplus and most even receipts of milk ever known on the Detroit market were obtained in 1931. The over-supply of country milk relative to lowered city demand, however, in the summer of 1931 made many dairymen impatient of this check upon milk sales and, therefore, caused much criticism of the plan. Any other plan, however, which in any way checked the free selling of milk during this summer would have been disliked to the same degree.

Milk Prices to Farmers on the Detroit Market

The marketing of milk in Detroit by the Michigan farmer is done at present largely by proxy. The city dealer with his outfit of milk trucks, country receiving stations, and route men takes the milk from the door of

the farmer so the personal presence of the latter on the market is not needed. However, 12,000 of these dairymen of the Producer's Association contract to sell their season's output to Detroit through this agency, accepting the price which is gotten by this means. There are no consistent formulas by which milk prices may be set automatically by the dairymen-dealer sales conferences, nor any open markets where milk prices are made by competition. The price set at the previous conference may be used as the starting point for the new price, and additions or subtractions made as one side or the other has the better arguments. The cold logic of milk supply and demand is most influential in deciding the new price, but often an outside arbiter must be called in to cast the deciding vote.

Curiously enough, the exact price agreed upon for base milk at these conferences is not the price which is actually paid the farmer. Owing to the fact that all the base milk entering the city daily is not sold as base milk, a calculated price must be made by the association's officers who take this into account. Base milk as delivered to the city is always in excess, more or less, of the salable amount as bottled milk, and this excess is paid for at surplus milk prices plus the cost of haulage. The averaging of the payments for this extra base milk with the payments made for bottled base milk gives the actual price paid by the dealers for city milk, and this becomes the real market price of the period. Surplus base milk of this sort is normally, each day, 10 or 15 per cent of the entire city supply of base milk, and serves effectually to lower the market price below that of the conference price.

Dealers' monthly sales of both kinds of base milk are the data used in getting the ratio of surplus base milk to bottled base milk, and the average price made on this basis becomes the uniform one for all dealers. The Detroit milk shed has enjoyed, therefore, under this plan the benefits of uniform milk prices, since every farmer gets the same milk price no matter to which dealer he sells. Individual dealers have not fared so well under this plan. It is easily seen that a dealer with much surplus would, in paying this average price, suffer a loss since surplus milk is sold at a lower price than this average, while dealers with much bottled milk profit greatly by paying the average price, since this price as shown above is much less than bottled milk prices. No plan has been adopted by the dealers for smoothing out these faults though seemingly a dealers' pool would remedy the situation.*

The Detroit market milk price during the year of this study twice escaped the evils of a badly swollen supply of surplus base milk, laden as it is with heavy haulage charges. These escapes were made by the action of the Producers' Association in reducing evenly on two occasions each member dairyman's base by a certain per cent. In the first case, in March, the abundance of milk in the Detroit area caused a cut of 20 per cent to be made, while in the following December, the over-supply continuing, a further cut of 15 per cent was made. Without doubt, a great saving to the members was effected by keeping in this way a large surplus of base milk from coming to the city where it would have depressed unduly the average or market price.

Prices for surplus or manufacturing milk are also agreed upon at these

*By late autumn of 1931, the dealers were unable to continue this source of loss to themselves for a longer length of time. Competition in the Detroit market had become so keen that possible sources of loss of every sort must be cut out and the determination of pay-off prices to producers are now made according to the individual sales of both kinds of base milk made by each separate dealer. The desired uniformity of price to producers may be taken care of, however, in the future by the price pooling plan adopted by the Producers' Association on February 24, 1932.

dairymen-dealer conferences, but with much greater facility than in the case of base milk, since at best milk of this sort is more or less a remnant as compared with the entire milk supply. A fairly uniform rule is followed everywhere, therefore, in making prices for surplus or manufacturing milk. This price is determined by the use to which surplus milk is often put, namely that of being made into butter, and provides that the New York butterfat price shall be the price paid for surplus milk. In some cases, further addition is made to the price for the value of the buttermilk by-product arising from this use but in others no addition is made. In Detroit, a 20 per cent premium on butterfat prices was formerly paid for this by-product but, since 1929, no allowance has been made for this element, thus lowering surplus prices not a little.

Farmers' monthly milk prices per hundredweight for base milk which was used as city bottled and as city surplus milk; also the price for that received at country stations for manufacturing purposes during the years 1929, 1930, and 1931, were as follows:

CALCULATED PRICE FOR CITY BASE MILK USED FOR BOTTLING PURPOSES, AND FOR CITY BASE SURPLUS

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1931	$2 27	$2 15	$2 35	$2 34	$2.24	$1 99	$1 93	$2 23	$2 31	$2 00	$1 84	
1930	2 73	2 57	2 58	$2 58	2 76	2 67	2 65	2 75	2 76	2 66	2 66	$2 48
1929	2 90	2 89	2 88	2 80	2 65	2 60	2 60	2 90	2 95	3 00	3 00	2 90

CONFERENCE PRICES FOR COUNTRY STATION SURPLUS

1931	$1 00	$ 99	$1 01	$ 91	$ 83	$ 82	$ 97	$ 98	$1 18	$1 01	$1 04	$1.02
1930	1 54	1 50	1 57	1 62	1 46	1 38	1 48	1 63	1 67	1 58	1 58	1 45

NOTE: To arrive at farmers' net prices, an average deduction for transportation should be made from city milk prices of 50 cents (30 cents average motor truck rates from country milk station to city, plus 20 cents average milk collection rate from farm to station). The 20 cents deduction should be made also from country station prices for surplus milk in order to arrive at farmers' prices.

Prices for milk to the farmer upon the Detroit market, this virtually means the Michigan market since no other Michigan city would have normally a higher price than the metropolis, plainly have declined during the past three years, as shown by the preceding Table. This price decline for city base milk was much more pronounced for surplus. The drop in price for this latter class of milk has been extreme, equalling as it did, between 1930 and 1931, more than 25 per cent. The failure of city demand for milk, as will be shown on a later page, together with the fall in commodity prices, generally, are the main causes for the declines in both classes of milk.

City Milk Dealers and Prices to the City Consumers

The final marketing of the fluid or whole milk of the State is handled by city milk distributing plants located in towns and cities. Lately, the largest of these in Detroit have come under the ownership of two holding companies, the Borden and the National Dairy, the total Detroit milk sales of which equal 60 to 70 per cent of the city demand. The typical city milk plant with its processing and bottling outfit, its milk delivery wagons, trucks, and other equipment represents no small investment of capital; some of

the plants in Detroit have capitalizations in excess of $7,000,000. Milk is also retailed through stores, restaurants, delicatessens, and the independent wagon operators, so there is no lack of agencies for supplying the consuming public with the commodity.

Basic milk as a rule is sold by city dealers in three different ways. These are, in the order of their importance: First, from their wagons as bottled retail milk; second, from their trucks to stores and restaurants as bottled wholesale milk; and third, as unbottled or bulk milk to a small extent for cooking purposes. The prices received by the dealer vary in accord with the outlet for the milk. In the Detroit market, retail bottled milk was sold in November, 1931, for 11 cents per single quart, bottled wholesale milk for some 2 cents per quart less, and bulk milk for a still lower price; price discounts were allowed from any of these prices for large orders. Since the sales of these two latter classes of milk make up nearly half the entire sales of the market, it is plain the average price per quart received by the dealers is much less than the quoted retail price with which the consumer is familiar.

City demand for milk, while fairly uniform throughout the year in comparison with country output, nevertheless fluctuates from day to day. The supply of base milk received daily by the dealer exceeds city demand by 10 to 15 per cent of the total city supply. This is the surplus base milk mentioned before, and is regarded by the dealer as a margin of safety in making sales. The dairyman receives only surplus prices for this milk, and complains that he is providing the dealer with a safety margin at no cost to the latter, but at much cost to himself. The complaint is hardly fair, since both dairymen and dealer desire an ample supply of milk so that every buyer's demand shall be satisfied fully. Besides, this milk like all base milk is fully processed and bottled by the dealer and is carried around upon his wagons for sale. Certainly, services of this sort are not without expense. But, since this surplus base milk is commonly used by dealers for skimming purposes and usually obtains from it the valuable by-product, sweet cream, the classification of this latter by itself, as proposed upon a later page, may furnish the remedy for this disagreement. Further, in addition to this city delivered base milk for bottling purposes and for base surplus, the farmer from day to day may deliver to the dealer's receiving stations the remainder of the milk under contract. Since this is milk in excess of the needs for city trade this, too, is looked upon as a surplus, daily surplusage, as compared with the seasonal surplus mentioned on an earlier page.

Surplus milk must be disposed of each day by the dealer before its freshness is gone, and a long list of milk by-products is the result. Named in the order of their importance in the Detroit market these by-products are sweet cream, ice cream, butter, cottage cheese, powdered milk, butter-milk, skimmed milk, chocolate milk, and some seven or eight more. The ingenuity of the city dealer is often taxed in order to sell these by-products at a profit. During 1931, however, by-products have played an unusual part in the milk trade. They, instead of whole milk, have been the major sources of profit to the larger Detroit dealers. Usually, surplus milk of all sorts makes nearly a third of the dealer's daily purchases.

The Producer's Association and the city dealers jointly support, to the extent of $70,000 per year, an ambitious agency, which has for its purpose the development of demand for milk among Detroit consumers. The name of this seven-year-old agency is the Detroit Dairy and Food Council, numbering on its staff a dozen or more workers. The Council's work is done by

urging upon the public, generally, the benefits from a larger milk consumption. This it does through lectures in the public schools, radio talks, movies in public places showing milk data, and the distribution of milk pamphlets through milk salesmen, the mails, and the press. While the exact benefits from efforts of this sort can never be accurately measured, one may safely say that no salable food article in Michigan is pushed upon the market with more vigor and skill than milk. The Dairy Council has renewed its efforts to promote milk demand in the present depression, going to the extent, even, of writing personal letters to milk customers who have lessened their purchases of the food.

The city milk dealers have maintained for several years a trade association under the name of the Dairy Products Research Bureau. Thirty-seven of the larger and older milk firms are members of this association, and, under the direction of a capable manager, the economic and general interests of these companies are looked after. During the past summer, the newer and smaller milk firms have organized a rival trade association, as a result doubtless of the intense competition upon this market this year.

Effects of Business Depression on the Milk Industry

The Michigan dairy industry has suffered from the business depression as have other industries. Sympathetic responses to business changes are promptly registered by milk, since, according to a well-known milk specialist, "this food is about the first to be cut out or reduced by the housewife when in straitened financial circumstances."* The acute decline in butter prices during the present year, reaching in June, 1931, 24 cents per pound, the lowest price in the present century, furnishes striking proof of this claim of sympathetic response, and the following data serve merely to indicate the degree of the distress.

A calculated average cost of producing milk for 700 cows for the first 6 months of 1931 taken from feed records supplied by the Michigan cow testing associations and from basic data furnished by previous milk cost studies was provided by the Farm Management Department of the Michigan State College. This calculation showed an average cost of $2.03 per hundredweight for 3.5 milk, or about 4½ cents per quart for milk produced during this period by several scores of Michigan dairymen. A questionnaire sent out by the Governor's Milk Commission in August to 400 dairymen inquiring about the costs of producing milk for the city market was answered in great detail by 136 of these farmers. The answers showed the average of the costs per hundredweight, as reported, to have equaled $2.13, with a high cost of $3.60 to one farmer and a low cost of $1.40 to another.

Besides these data eight dairymen having herds which varied in size from 12 to 26 cows and having cost records kept by cow-testing accountants showed average costs of $2.20 for the first half of the year. Add to each of these totals 50 cents as the average cost per hundredweight for transporting milk to the Detroit market from the Michigan farm and the entire expense of the farmer is obtained. Plainly, at the Detroit prices for milk shown on an earlier page and with the production costs just given, the Detroit area dairyman has lost heavily during the year.

*Prof. E. L. Anthony in a letter to the writer.

Milk Dealers' Losses from the Depression

The city milk dealers also have suffered from the depression. A careful examination of the accounting records of leading Detroit dealers by a well-known certified accountant firm showed a loss upon bottled milk during the first seven months of 1931 which equaled nearly one cent per quart. Of 15 Detroit milk dealers whose statements were taken, seven claimed to have made no profit of any sort during the first half of 1931, especially during the months of June and July, while the remaining eight made only moderate profits.

The chief cause for these losses to city dealers has been the decline in milk consumption due to city population shrinkage and to the generally lowered purchasing power of consumers. The sales of bottled milk in Detroit, for example, as shown by the records of six large dealers, declined from the daily total of 455,700 quarts in June, 1929, to 302,250 quarts in July, 1931, a fall of one-third. The year (1931) has shown a steady monthly decline in sales for these companies from 334,800 quarts daily in February, to 302,250 quarts daily in July, although this latter month is normally one of the peak months for city milk sales. The falling off of milk consumption in Detroit is, in fact, estimated by dealers to equal from 20 to 30 per cent of the normal consumption as a result of the two causes named above.

Many Detroit distributing plants are built, equipped, and staffed for handling much more milk than is at present their portion; they are, therefore, suffering a loss on fixed charges. Collections are also made more difficult by the depression, one dealer estimating that a deduction of 1 per cent of total sales would scarcely equal the loss from this cause.*

Dealers' Competition and Milk Handling Costs

Milk marketing by city dealers is a highly competitive business with highly intensive sales methods and many competitive costs and wastes. Grocery stores and similar retail agencies, it is claimed, sell 40 per cent of the retailed milk in the city, and this class of large milk buyers provokes the severest competition among the city dealers. This is true not only because of the desirable wholesale character of this trade, but also because there is no openly quoted price for such milk as is true of that retailed from house to house.

Price sharing as between the country dairyman and the city dealer by which the price received from the city consumer or customer is divided is a matter of endless dispute between these claimants. Practically, this division is settled at the periodic sales conferences of the two groups and may follow one or the other of many patterns. In the long run, however, the minimum share acceptable to either group is of course the costs of production to the dairyman and the costs of handling to the dealer. For dairymen, these costs were given on a previous page, and for dealers they now receive a similar attention. Costs of these sorts for standard milk were secured by a certified accountant from the books of the larger Detroit milk dealers, and are as follows:

*The credit side of the milk dealer's business is in normal times a serious drain. Competition among dealers causes much selling upon credit and the same force seemingly hinders any unified move in making collections. Customers buy from one dealer on credit to the limit, then from another to the same extent until the rounds have been made, a period of time authoritatively estimated as three years. One dealer claims never to have cut off a customer on account of credit.

Average Costs per Quart to Dealers for Handling Both Wholesale and Retail Bottled Milk in Detroit in the First Six Months of 1931

FLUID MILK

Country Station Costs	$0.0050
Costs of Processing	.0064
Costs of Delivery to Customers	.0347
Sales Expense	.0080
Administrative Expense	.0038
Total Distributor's Cost per Quart.......	$0.0579

Milk delivery to the customer, it will be noticed, is far and away the heaviest of dealer's costs. This, too, is the side of the milk business most harshly criticised by the public because of the easy observation that milk wagons are too abundant upon the streets. Making up the delivery total given above, it should be said there are included the heavy costs of emergency deliveries to customers, and also the losses from bottle wastage and bad collections. The many dealer's services required by city milk consumers, by city ordinances and by state laws, when added to the natural milk handling charges, make a heavy expense. The outlook for the future, therefore, for a less cost than six cents per quart for the city handling of milk is not bright. Naturally, of course, some radical changes may be discovered as to methods or materials in city milk marketing which may have the desired effect of lessening costs, and is all the more a possibility, too, since handling bottled milk is distinctly a new industry.

Dealers' Competition on the Detroit Market in 1931

Competitive conditions among Detroit dealers were severe during the year. Price cutting was widely prevalent. Some stores, indeed, advertised milk at six cents per quart and even less, while the regular price was 11 or 12 cents. In June, a reciprocal injunction was granted by a local court restraining 12 milk companies from interfering with the milk bottles of one company, and this latter from interfering with the bottles of the 12. In Grand Rapids, two milk producers' strikes took place during the summer with the usual results of loss to both producers and dealers, and also the loss of consumers' good will. A Detroit dealer for some time gave bottles free to stores as a method of meeting the price cutting of a rival. Costly bottles were condemned to destruction by this method with resulting economic waste to the public since no storekeeper, of course, would carefully save bottles which had cost him nothing and for which he received no reward for saving.

The field of opportunity for competitive misdeeds by Detroit dealers may be fairly accurately estimated by noting the rules drawn up to prevent such misdeeds, since certainly sensible men would scarcely declare prohibitions upon practices which did not exist. The Dairy Products Research Bureau issues a code of business ethics for Detroit dealers which, among other provisions, contain the following: (1) not to misrepresent goods, (2) not to subsidize janitors of apartment houses, (3) not to make free gifts of goods in order to influence business, (4) not to use extraordinary publicity organs for advertising, (5) not to use competitors' bottles or other containers, (6) not to bribe or subsidize competitors' employees, (7) not to practice predatory

competition, (8) not to tell untruths about the pasteurization or butterfat content of milk, and (9) not to misrepresent a competitor.

The Governor's Milk Commission took special notice of a further competitive practice not included in the code list as being forbidden, and declared strongly against it. This was the practice of using a misleading name, title or brand for a milk business or a part of it, such as the title "Jersey Creamery" for example, for a milk plant at which other than Jersey milk is sold.

The Commission says:

"There was much evidence of misleading and in some instances illegal labelling of milk products. The law enforcement agencies should take immediate steps to enforce the correct labelling of buttermilk, cultured buttermilk and Jersey milk. There is a widespread practice in the Detroit area of building up milk, low in butterfat content, by adding cream, frequently from uninspected areas. Little of the buttermilk sold as such in Detroit is true buttermilk, but is manufactured by the culture process. Only a part of the Jersey milk sold as such comes exclusively from Jersey cows. Common honesty, as well as the law, should compel the sale of all of these wholesale products under their true names. Restored confidence would stimulate consumption."

Competition among milk dealers has more bad features than is true of this practice in other lines of trade. Milk supply has some of the qualities of a public utility. The consumers expect it to be standard quality and to be regularly supplied at a just price, the same as are gas and electricity. A city's supply, therefore, is seldom benefited through being left to the risks and struggles of dealer's competition. In fact, the many economies of the large distributing plants, as compared with small ones, emphasizes strongly the advantages of centralized handling of the business by a single plant rather than the handling through the competition of many. In not a few respects, the competitively minded public is much to blame for the wastes and privations of milk rivalries, burdensome though they are; undoubtedly it believes that when milk dealers fall out the public's milk interests are looked after best, a fallacy of the most serious sort.

Surplus milk in the country, due to under-consumption in the cities, was no small cause for the tense rivalry among dealers during the year. The volume of milk produced in the Michigan dairy region in 1931 is estimated, in fact, to have equalled fully the volume of former years, since herds were no smaller, and pasturage and feed conditions were much better than during 1930.* As a result, the milk yield in the Detroit area for the first months of 1931 was so excessive that in March the Producers' Association took the extreme measure of cutting down the base by 20 per cent, as stated on an earlier page. The city dealers, in June, accepted a cut in the city retail milk price of two cents per quart. The new retail price of ten cents thus made was the lowest since the World War, and had for its purpose the stimulation of consumption to a nearer parity with production.

Plentiful and low priced country milk furthermore caused some city dealers to abandon the collective bargaining plan of the organized milk trade hitherto used and to buy milk on the open shop or free-lance basis. Independents, as these buyers were called, secured milk wherever it could be bought at greatest advantage, and assumed none of the surplus expense or the demand creation costs which are incurred through Dairy Council efforts, which the regular dealers support. Independent dealers are thus en-

*The country supply of milk by the end of this year, in fact, had become so excessive that on Feb. 24, 1932, delegates to a special meeting of the Producers' Association voted the employment of special plans for disposing of this surplus without offering it upon the Detroit market. They also voted to pool receipts from the base milk for Detroit milk shed dairymen without regard to its method of disposition. The new plan was to go into effect on March 1, 1932.

abled to cut city prices below those of the organized dealers, and thus set the city's entire milk business by the ears. They exploited, in fact, the troubled condition of the Detroit milk business wholly for their own gain. Occasional milk dealers, as some of these independents are, take all the gainful "breaks" that a milk situation affords, and leave to the organized milk industry all the bad ones. They offer little in the way of a permanent gain to country dairymen or to city consumers. The dairymen at least should realize the troubles escaped through having a sales making association for bargaining with the dealers; they at any rate should not be tempted away during this preiod of low prices from the Association which for many years has handled their milk business with success.

The Milk Use Pay-off Plan and its Extension

The city milk dealer, as shown on a previous page, has a wide range of uses for the milk at his disposal, bottled milk, sweet cream, butter, cottage cheese and many more, some of these with prices made locally and some with prices made on a world market. The plan has been adopted in several cities, notably in the nation's metropolis, of making payments for milk to groups of dairymen in accord with the use to which it is put, one price for milk used in bottles and others for milk used in milk powder, butter, cottage cheese, or other products. This, in brief, is the "milk use pay-off" plan worked in New York to the extent of dividing its daily milk supply into seven or eight portions for each of which a different price is paid.

The Use Plan as a pay-off method on the Detroit market has been employed to some extent. The milk used as bottled milk, for example, has been paid for at one price, while the milk not so usable, the surplus, has been paid for at a lower price. The merit of this plan is, briefly, that of paying the milk producer the entire amount he has a right to expect for his product. No one of course should expect a higher price for milk than is received from the consumer. Nor should anyone expect the same price for milk used for high product purposes as for milk used for low product purposes. Further, this plan grades the returns to the dairyman in the same way they would be graded if he were retailing the milk himself since only a definite quantity of bottled milk may be sold in any city. The classes of milk are not numerous enough, however, in the Detroit market to render entire justice, since surplus milk itself has several uses, some of which yield greater profits than others.

Surplus milk, as was said above, is turned into a variety of by-products of which sweet cream, butter, and ice cream are the chief. The first of these for one of the largest Detroit milk plants during the first half of 1931 brought returns valued at a sixth of the total sales receipts of this company. Sweet cream is thus seen to be a big item in the city milk market; in fact, certain wholesale dealers handle nothing but sweet cream, importing much from other states. The average retail price for sweet cream for this large milk plant was 44 cents per quart, and the average profit per quart was 20 cents.

Plainly, returns of this amount make it possible to pay a higher price for the sweet cream milk than is possible for milk used to make products which sell for less. The costs of sweet cream to the company in question was $0.2345 per quart, 5 quarts of 3.5 milk making 1 quart of sweet cream. Obviously, milk which may be sold in the profitable form of sweet cream should receive a higher price than 2½ cents per quart, the present pay-off price for surplus milk. Other cities besides New York give sweet cream an

especial place in their scales of surplus milk prices, and leading milk dealers in the Detroit market admitted the justice of the sweet cream classification. The classifying then of surplus milk so that sweet cream portions shall receive an adequate price is a further application of the Use Plan which should be made on the Detroit market.

Limiting the Detroit Milk Area

The shape of the Detroit milk area, due to the presence of Canada and the Great Lakes upon the northeast, east, and southeast is that of an open fan with its handle based upon the city itself. The outer edge of this fan begins at Bay city and passes through the cities of St. Johns, Grand Ledge, Albion, Coldwater, to the State line, and the effect of this fan-shape is to make milk hauls longer than would be the case if supplies were obtainable from all sides of the city. Maximum hauls in the Detroit milk area are now over 100 miles in length and the extension of good roads and the substitution of motor trucks for railways as milk carriers tends steadily toward making longer hauls physically possible.

The Detroit milk shed has been pushed to its present size largely through the past actions of city dealers during times of milk shortage. The means of relief in such crises are found in erecting milk receiving stations in new territory, and the added dairymen thus reached, having joined the Producers' Association as a matter of course, now become permanent members of the Detroit area. The activities also of newly established city dealers in seeking new sources of milk supply have had much to do with the enlargement of the area, since, with the receiving stations of the old companies already fully dotting the original area, there was no room for the new companies. The evils of so large a milk shed are shown in the added costs of transportation incurred in the enlargement of the city's supply which already suffers from over-supply, and in the increased costs of Board of Health inspection over so large an area.

The Governor's Milk Commission of 1931 recommended in respect to this matter:

> "We believe that the territory contiguous to our cities should furnish milk to those cities and that the nearest producers have a natural right to that market Any other plan is wasteful and uneconomic. City authorities should adopt drastic measures to insure their milk coming from the nearest territory. The Board of Health of the City of Detroit shou'd materially limit the producing area, and should inspect all cream produced for its market. Boards of Health of other cities should do likewise."

The present is a most favorable occasion for carrying out some policy of limitation by Boards of Health since the usual opponents of the plan are for the time giving their approval. City milk dealers normally hostile to any limit upon their supply sources, now find themselves so surfeited with the fluid as to give ready assent to cutting down the output. The opinion expressed above by the Commission, "The Board of Health should inspect all cream produced for its market," is also helpful in this matter. The inspection of cream, indeed, is held by some to offer a plan by which the present milk shed borders may be kept intact without requiring the exclusion of old members of the Association from their former privileges. Should the inspection of cream go into effect, some claim, as is the case now in New York City, that outside sources of cream would be shut off, and the entire present Detroit area would be needed to supply the local demand for milk and cream. Pittsburgh, among cities of a comparable size with Detroit, has practiced with success the limiting of its milk area through the more rigid and effective work

of Board of Health control, and general sympathy with the plan as a remedy for Detroit's difficulties was found among all classes of milk interests.

Summary

1. The decline in population and buying power of Detroit and other cities in the Detroit milk area have lessened milk consumption, thus tending to cause country over-production.
2. The price of butterfat, set in a world market, has been the lowest of any time in three decades. This has depressed the price for surplus milk.
3. The Michigan Milk Producers' Association has had difficult problems to cope with, much more milk to sell than was required by the market and a restless membership, but has continued to show the merits of farmers' cooperation in collective bargaining in respect to milk.
4. Milk dealers in the Detroit market have been stirred to extreme competition during 1931 by the large amounts of milk brought to the market by small and irregular dealers taking advantage of the low-priced country supply.
5. Neither farmers nor city dealers have profited normally in handling milk in 1931, but the former have suffered the larger losses.
6. The wastes of abnormal competition among Detroit milk dealers in 1931 suggests the wisdom of closer cooperation on their part as a means of saving expense.
7. Surplus milk in the Detroit market should be classed as to use, so that the portions from which sweet cream is made at least may receive a suitable price.
8. The Detroit milk shed should be limited as to size. This and the inspection of sweet cream are suggested as proper duties for the Boards of Health of milk area cities.
9. Country dairymen are urged to maintain their relations with the Producers' Association. The experience of American cities for a quarter of a century in respect to milk supply shows that dairymen, city dealers and city consumers reap the maximum benefits from a well organized cooperative milk industry working in full harmony.

RED-NECKED CANE-BORER, *Agrilus ruficollis*

and

RASPBERRY CANE-BORER, *Oberea bimaculata*

RAY HUTSON, SECTION OF ENTOMOLOGY

Two insect pests affecting raspberry canes that have caused damage in other sections for many years have been the cause of considerable concern among Michigan raspberry growers for the past two years. These pests have always been present in Michigan, but for some reason or other conditions

have not favored them sufficiently for their presence to be noticed more than casually. These two pests are the red-necked cane-borer, which causes a swelling known as the gouty gall on raspberries, blackberries, and dewberries, and the raspberry cane-borer, which damages raspberry canes by girdling them at the time the eggs are laid, thereby causing them to break off with the resultant deformation of the plant.

Rednecked Cane-borer—As its name indicates, the red-necked cane-borer has a reddish- or brassy-colored thorax or neck. The remainder of the insect's body is a dull, bluish color. The adult beetles are about one-third of an inch long. The females lay their eggs in June and July in the bark at the base of leaves on new growth. The tiny larva which hatches from this egg burrows upward in the sapwood of the cane in a spiral course, going around the cane five or six times. This results in girdling of the cane and is responsible for the characteristic gall formation, which we may call the

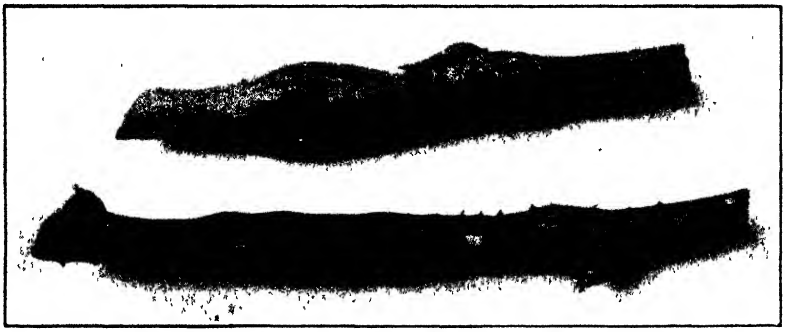

Fig. 1.—Gouty gall on dewberry.

signature of this insect. On raspberry canes this gouty gall, as it is sometimes called, ofttimes shows the circular path of the insect, but on dewberries and blackberries the typical form of the gall with its longitudinal splitting of the bark is more common. After girdling the cane, which favors the grub by slowing down the growth, the pest penetrates to the pith of the cane and bores upward, usually for several inches. It is in this location that the winter is spent as a yellowsih-white, slender, somewhat flattened grub about five-eighths or three-fourths of an inch in length. The head capsule is brownish and the tip of the abdomen is provided with two short, brown hooks. Early in the spring the red-necked cane-borer completes its growth and later, usually in May, the adult beetles begin to emerge, thus completing the life-cycle.

Raspberry Cane-borer—The raspberry cane-borer is a native insect which is generally distributed over the northern United States and Canada. The adult is a long-horned, slender-bodied beetle, perhaps one-half inch in length, of a dull black color and possessing a yellowish thorax with two or three black spots on its upper surface. The females deposit their eggs singly about six inches from the tips of new canes, usually in June. The injury which directs the attention of the grower to the fact that these beetles are at work is the deadened appearance of the tips of canes in which these eggs

are laid, for before depositing an egg the female beetle makes two rows of punctures around the cane, approximately one-half inch apart. It is between these two rows of punctures that the egg is laid. As a usual thing, these eggs hatch in July, and the larvae start burrowing downward. They pass the first winter in a partly-grown condition an inch or two below the girdle. The second season the larva continues boring downward in the cane, usually killing it before the fruit matures. The larva continues boring until it reaches the ground level, some time in early fall. It then remains in the cane until the following or second spring after the laying of the eggs, when it comes out as a mature beetle.

Control—The above facts of life-history and habits of these can-borers are detailed for two purposes: 1. By noting the character of the borings you can tell which of these pests is causing the damage. 2. To make plain the fact that both of them spend the winter-time in the cane. Injured canes can be removed in the ordinary process of pruning if a little attention is paid to the removal of deformed canes. In well-pruned raspberry plantings, of course, there will be very few of the beetles surviving in any case, but just a little additional care will eliminate the larger percentage of infestation by the red-necked cane-borer and materially reduce the infestation by the raspberry cane-borer. The best results, of course, will follow the pruning if all the canes are burned immediately after pruning. In the case of the raspberry cane-borer, it is well to remember that new canes should be pruned several inches to a foot below the place where the eggs were laid. Some growers follow the practice of cutting out and burning the wilted tips.

Since both these beetles infest raspberry plants growing wild in fence corners and other places, it should be apparent that anyone attempting to eliminate borers from a raspberry planting should make an effort to clean up, insofar as possible, all the canes in the vicinity of the planting which it is desired to protect.

OLDER DAIRY BULLS BEING USED IN MICHIGAN

CLAIRE NELSON AND G. A. BOWLING, SECTION OF DAIRY HUSBANDRY

The selection of a herd sire is just one of the problems that must be solved by an average dairyman. However in the case of a dairyman who is above the average this problem of sire selection becomes of major importance. In fact it can safely be said that the importance of this problem increases in direct proportion to the producing ability of the herd.

Not many years ago the good dairyman thought he had fulfilled his obligations to his herd of female cows by securing a sire that was registered or at least eligible for registration. Only a few dairymen really cared about any production records back of their sire.

Today the good dairyman wants to know more about his herd sire than just the fact that he is purebred and perhaps from the heaviest milking cow in some herd. Proof of this is seen in a survey of the bulls owned in 33 Michigan Dairy Herd Improvement Associations for 1931. Pedigrees of

378 bulls were secured and placed in bull record books by the testers of the 33 organizations. In 268 cases, or 70.6 per cent, records of some kind were made by each bull's dam. The kinds of records made by the dams are as follows:

1. Twenty-five dams had 7-day or 30-day records only.
2. Two hundred forty-three dams had a yearly record of milk and butter-fat.

The relative size of these yearly records are as follows:

32 dams produced less than 400 pounds of fat.
211 dams produced more than 400 pounds of fat.
144 dams produced more than 500 pounds of fat.
85 dams produced more than 600 pounds of fat.
38 dams produced more than 700 pounds of fat.

It is interesting to note that 32 per cent of above records were made in dairy herd improvement association work.

The necessity of keeping well-bred bulls until some of the daughters freshen has been stressed for several years. The majority of bulls in use are not an asset to the breed they represent, but now and then bulls are developed that prove to have more than the usual ability to transmit high production. Dairy herd improvement association members are urged to keep their sires in order that the outstanding animals may be discovered and their usefulness prolonged. The following table shows the per cent of bulls in the different age classes for the years of 1930 and 1931. All of the bulls listed in bull record books by cow testers were used in this tabulation.

Age Trend of Bulls Owned by Members of Michigan D. H. I. A. for 1930 and 1931
(Per cent of bulls in each age class)

	1930	1931	Increase or Decrease
	Per cent	Per cent	Per cent
Under 1 year of age	10.0	3	− 9.7
One year and under 2 years of age	27 0	7 0	−20
2 years and under 3 years of age	23 5	23 0	− 5
3 years and under 4 years of age	20 1	23 0	+ 2.9
4 years and under 5 years of age	9 0	15 7	+ 6.7
5 years and under 6 years of age	5 3	10 8	+ 5.5
6 years and under 7 years of age	2 1	8 3	+ 6.2
7 years and under 8 years of age	1 1	4 6	+ 3 5
8 years and under 9 years of age	.9	2 6	+ 1.7
9 years and under 10 years of age	6	8	+ .2
10 years and under 11 years of age	4	1.4	+ 1.0
11 years and under 12 years of age	0	1 1	+ 1.1
12 years and under 13 years of age	0	1 1	+ 1.1
13 years or over	0	3	+ .3
Total	100%	100%	

The above table shows that there were 30.2 per cent less bulls under 3 years of age in 1931 than in 1930. On the other hand the number of bulls 3 years of age and over increased 30.2 per cent. The average age of all bulls listed in 1930 was 3.77 years, while in 1931 the average age was 4.1 years.

The results of this survey of bulls kept in Michigan Dairy Herd Improve-

ment Associations show two things of major importance: First, that these dairymen are selecting bulls with record dams, and second, the tendency is to keep these bulls for a longer period of time.

THE INFLUENCE OF BEES UPON CLOVER AND ALFALFA SEED PRODUCTION

C. R. MEGEE AND R. H. KELTY, SECTIONS OF FARM CROPS AND HORTICULTURE

It is common observation that along with the decrease in the numbers of bumble bees and other wild bees there has been a decrease in the production of clover seed. It has generally been supposed that the honey bee is too small to be of assistance in pollinating clover and too light in weight to trip alfalfa blossoms. This experiment was planned to determine whether the pollinizing activity of honey bees and certain other insects influence the production or yield of alsike clover, June or medium red clover, and alfalfa seed.

Procedure—Areas were selected in Chippewa County in the Upper Peninsula and in Cheboygan county in the northern part of the Lower Peninsula where there were no honey bees in the locality except those brought in for the purpose of this experiment. In the areas selected in Chippewa county, alsike and June clover seed are produced commercially and in the area selected in Cheboygan county alfalfa seed is produced commercially.

A series of cages 36-in. x 36-in. were constructed and a portion of these cages covered with a very fine mesh nainsook to restrict the very small insects present at the blooming period and to exclude the larger insects and the bees. Another portion of the cages was covered with wire screen of 1/8-inch mesh to allow the smaller insects free access to the blossoms but to exclude the bees. The cages were placed on the alsike, June clover, and alfalfa plants previous to the opening of the blossoms and at varying distances from the honey bee colonies which had been moved into the fields.

To obtain a concentration of honey bee activity within a cage, a hive of honey bees was placed half way into one side of the cage. The bees were given an entrance, into the cage through the rear of the hive but they also used their regular entrance through the front of the hive. An opening about 6 inches square was made in the top of the cage to allow the bees to leave the cage readily in case they did not return to the hive. The second year of the project, 1931, one of these cages containing bees was placed over alsike clover, one over June clover, and one over alfalfa plants.

Observations—Small insects were very numerous among the uncaged clover and alfalfa plants in the field. By sweeping the plants with a collector's net it was found that the majority of the small insects were leaf bugs, leaf hoppers, plant lice, and flies. Several kinds of small wild bees were present in moderate numbers and were actively visiting the blooms in the

open field when weather conditions were favorable. However, cool winds and cloudiness greatly reduced their activity.

Bumble bees were not plentiful. During one two-hour period of observation, although weather conditions were favorable for insect activity and small wild bees were very numerous and active, but three bumble bees were observed in a twenty-acre field of June clover. When air temperatures ranged from 75° to 90° F., all of the insects under observation were active in the field during the blooming period. When the temperature dropped to 65° F., only the bumble bees and honey bees were observed flying, although the other insects had been very active at high temperatures earlier in the day. At 60° F. honey bee activity had practically ceased, but the bumble bees were still working.

Though it was the intention to exclude all insects from the cages covered with cloth, a few small insects such as leaf bugs, leaf hoppers, plant lice and flies were observed on the plants. It is probable that these small insects were sheltering among the plants or in soil when the cloth cages were placed over the plants.

Results—Clover plants under only 3 of the 16 cloth cages produced seed, the average number of seeds per head being 2, 2 and 3, respectively (Tables 1 and 2). In one case the plants in an adjacent alsike screen cage containing a single bumble bee produced an average of 48 seeds per head. It is evident that the blossoms of June and alsike clover are not automatically self-pollinating but require some agency, such as honey bees, to transport pollen from stamens to stigmas.

In the screen cages a large number of leaf bugs, leaf hoppers, plant lice and flies were observed. These insects apparently do not effect pollination of clovers as no seed were set in these cages, except when either a bumble bee or honey bees were present in them (see Tables 1, 2 and 3).

That bumble bees effect pollination is shown in Table 2. One bumble bee was confined in each of three screen cages over alsike clover and seeds were set in a number of heads of clover in each cage. Many heads of alsike clover in these cages contained no seeds, however, indicating that the bumble bees were erratic and failed to visit many blooms, although confined to the cages throughout the blooming period. In the open field, bumble bees usually flew farther between visits to blooms than did honey bees under similar conditions. This characteristic, together with the scarcity of bumble bees in the district, indicates that bumble bees cannot be relied upon to pollinate enough blossoms to produce a heavy seed set.

The small wild bees were comparatively few in number. Although the mesh of the wire screen cages was large enough to permit the smaller species of bees to enter the cages, none were observed working on blossoms in any cage. The fact that some of these small wild bees were observed gathering pollen indicates that they may effect pollination to some extent. However, due to the relatively small numbers present and their inactivity during adverse weather conditions, it is probable that they cannot be depended upon to pollinate a sufficiently large number of blossoms to produce a heavy yield of seed.

The data presented in Table 1 show that honey bees are very effective in increasing the production of June clover seed. Seed production was insignificant in the cages, both cloth and screen, where the honey bees were excluded. Of course bumble bees and perhaps other large insects could, and did, effect a certain amount of pollination of the blossoms in the field (next

Table 1.—Results of pollination experiments with June Clover.

Distance from honey bee colonies		Average number of seeds per head			
		Cloth Cage without honey bees	Screen Cage without honey bees	Field with honey bees	Screen Cage with honey bees
Welsh—1930	½ rod	0	0	103	..
	20 rods	0	0	106	.
	80 rods west	*	0	103	
	80 rods north	0	0	102	.
	120 rods north	0	0	79	
Welsh—1931	½ rod	0	*	56	46
	20 rods	0	6	51	.
Osborn—1930	1 rod	2	0	68	...
	30 rods	0	0	61	...
Stalwart—1931	½ rod	0	0	39	

*Cage removed.

to last column in Tables 1 and 2), but their observed scarcity indicates that they were relatively unimportant as compared with the honey bees. Furthermore, the fact that a satisfactory yield of June clover seed was secured in the screen cage where the colony of honey bees was so placed that the bees had free access to the clover blossoms within the cage, while bumble bees and other large insects did not, is entirely convincing evidence in this connection.

Table 2.—Results of pollination experiments with Alsike Clover.

Distance from honey bee colonies		Average number of seeds per head			
		Cloth Cage without honey bees	Screen Cage without honey bees	Field with honey bees	Screen Cage with honey bees
Wallis farm—1930	½ rod	0	0	62	....
	15 rods	2	48*	27	..
	40 rods	0	Cage removed	29	....
	80 rods	0	0	30	..
Wallis farm—1931	1 rod	0	20*	38	18
	80 rods	0	1	29	....
	160 rods	3	34*	35	....

*Bumble bee in cage.

The results with alsike clover, shown in Table 2, correspond very closely with those in Table 1 with June clover. Seed was produced in neither the cloth nor screen cages when the honey bees were excluded. Seed production was very materially increased by the presence of bumble bees and honey bees in the screen cages. The field checks where both bumble bees and honey bees had access to the blossoms produced seed freely.

The total number of alfalfa seed produced on an equal area was far greater on the field check plot and under the wire cage with honey bees than under the cloth cage and wire cage where honey bees were excluded. The

Table 3.—Results of pollination experiments with Alfalfa—Ostrander, 1931.

Distance from honey bee colonies ½ rod	Number pods on an area of 9 sq. ft.	Total number of seeds on an area of 9 sq. ft.
Cloth cage, no honey bees.	22	32
Wire cage, no honey bees.	96	283
Wire cage with honey bees	1,142	4,323
Field check plot	1,311	5,863

pollinating activity of the honey bees resulted in an enormous increase in both alfalfa pod and seed setting.

A field survey was conducted to determine the relative yields of fields freely and those not freely visited by honey bees.

Table 4.—Field survey.

Field number	Colonies of bees	Distance from field	Acres	Yield in bushels of seed
ALSIKE CLOVER 1930				
1.	70	½ mile west	23	6 4
2.	5	Adjacent	10	5 8
3.	5	¼ mile east	14	5.4
4.	None near		4	2 2
5.	None near		240	3 8
1931				
6.	70	½ mile west	52	5 4
7.	25	¼ mile west	16	4 7
8.	25	Adjacent	18	4 6
9.	70	2 miles north	[illegible]	3 0
10	None near		13	3 2
JUNE CLOVER—1931				
11.	5	Adjacent	20	5 7
12.	23	¼ mile east	3	4 9
13.	5	2½ miles west	15	0.0

This was made in the vicinity of Rudyard, Chippewa county, where clover seed is one of the important cash crops. There is one fairly large apiary near Rudyard and it has become the practice of this beekeeper to place colonies with farmers during the nectar gathering season, though if forced to do so bees will travel considerable distances in order to obtain nectar. However, if nectar is abundant the flying range is usually less than two miles. The fields included in this survey were regarded as comparable from the standpoint of soil fertility, condition and stand of plants. In no case did the fields visited only sparingly by honey bees equal in seed production comparable fields freely visited by them. Obviously the honey bees were effective in increasing the yields per acre of both alsike and June clover seed.

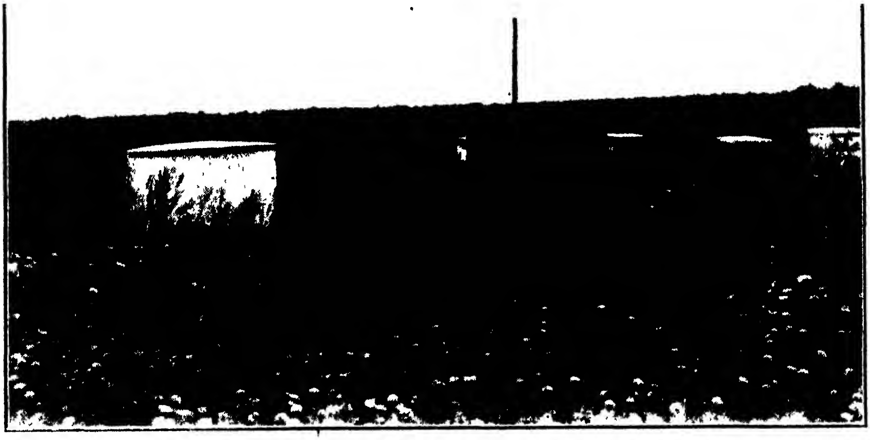

Fig. 1.—This photograph shows the construction of the 3-ft. x 3-ft. cages covered with nainsook and wire screen that were placed over clover and alfalfa plants at different distances from colonies of honey bees.

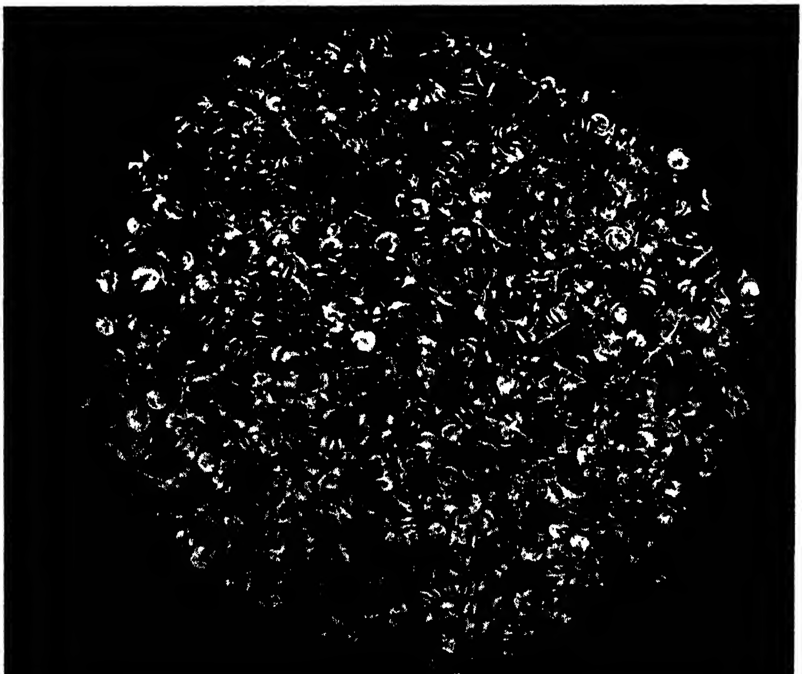

Fig. 2.—The alfalfa seed pods gathered from a representative area three feet square to which honey bees and other bees had free access during the blossoming season. Note the large number of pods and compare with Figures 3, 4 and 5, more especially 4 and 5.

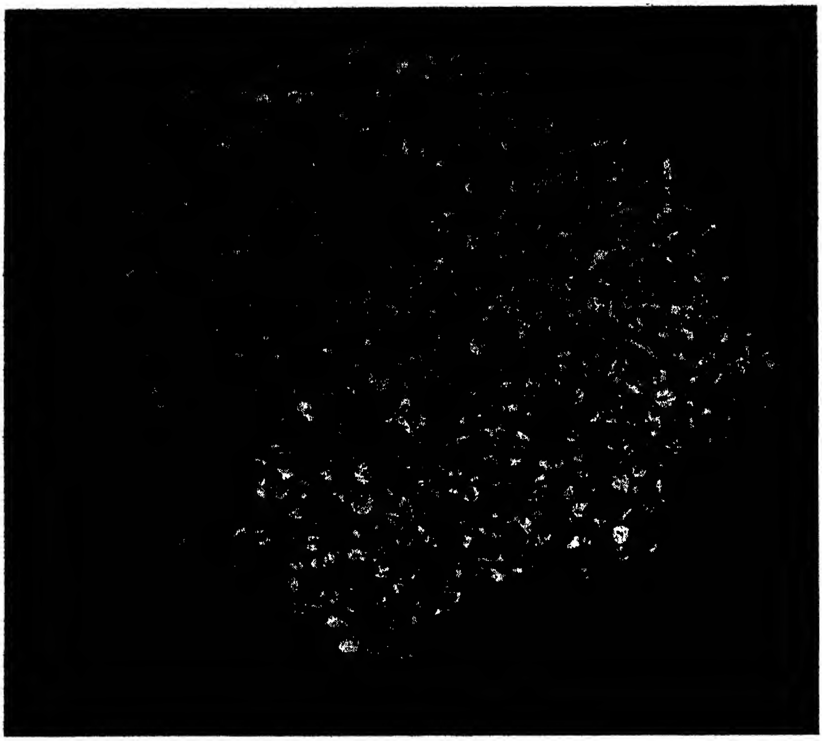

Fig. 3.—The alfalfa seed pods gathered from an area of three feet square covered with a fine mesh wire cage but inside of which honey bees were introduced during the blossoming season. Bumble bees and other large insects were kept out of this cage. Note the large number of seed pods and compare with Figures 2, 4 and 5, more especially 4 and 5.

Fig. 4.—The alfalfa seed pods gathered from an area of three feet square covered with a fine mesh wire cage during the blossoming season to keep out honey bees and other large insects. Note the small number of pods—and they were poorly filled with seed—as compared with Figures 2 and 3.

Fig. 5.—The alfalfa seed pods gathered from an area of three feet square covered with a nainsook cloth screen during the blossoming season to keep out not only honey bees but smaller insects that conceivably might assist in pollination. Note the small number of pods as compared with Figures 2, 3 and 4.

Conclusions

1. Small insects, such as bugs (Hemiptera) and flies (Diptera), that are present in large numbers in clover and alfalfa fields apparently do not serve as pollinating agents and are of little or no value in contributing to a setting of pods and seeds.
2. Bumble bees are effective pollinating agents, but, due to their relative scarcity in the clover and alfalfa seed producing districts of northern Michigan cannot be depended on for pollination purposes.
3. The honey bee was found to be a very effective pollinating agent for June and alsike clovers and for alfalfa and the presence of large numbers of bees resulted in marked increases in the seed crops of these legumes.

THE USE OF PAPER MULCH IN THE FOREST NURSERY

P. W. ROBBINS, SECTION OF FORESTRY

Paper companies and individuals have been attributing rapid growth, higher survival and lower production costs for truck garden crops and trees when planted through paper. State agricultural experiment stations have conducted experiments with paper mulched garden crops (1, 2). However, few figures are available on trees raised in paper. T. J. Starker (3) found that paper mulch is not as satisfactory as leaf mulch or cultivation for the production of Douglas fir transplants in the west.

In order to determine if paper mulching nursery stock is practical and beneficial, experimental plots were set out in 1930 and 1931 at the Dunbar

Forest Experiment Station nursery. The soil at this nursery is very fine, loamy sand, with no stones or gravel. The natural drainage is slow.

The experimental plots consisted of two blocks of 5,000 trees, one paper mulched and one check plot. Two-year-old white pine seedlings with four to six-inch tops and roots were used in the plots.

The stock was set two inches apart in the row and six inches apart between rows. The check plots were spaced two inches apart in the row and 14 inches apart between rows. The plant paper used in this experiment cost five dollars per roll. The rolls were 18 inches by 900 feet and weighed approximately 60 pounds. Planting along the edge of the paper would make the rows 18 inches wide, which is wider than necessary. Therefore, to conserve paper and ground area, the 18-inch rolls were cut into three narrow rolls, because in order to plant seedlings with a trencher and transplant board, a continuous cut is necessary.

The planting began with the opening of the ground with a trencher along a guide string for the first row and setting the seedlings. Then a strip of paper was rolled out on each side of the row and pushed against the seedlings. The edges of the paper were then covered with earth to hold them in place and the one edge formed the guide for the trencher for the next row, taking the place of a guide string. The unmulched plots were planted using a trencher and dibbles.

Table 1.—Comparison of production costs, sizes and dry weights of paper mulched and cultivated unmulched white pine. (Transplants 2-2 stock.)

	Planting Cost	Weeding Cost		Cultivating Cost		Paper Cost	Total Cost	Relative Size		Average dry weight per tree
	Per M	Per M		Per M		Per M	Per M	Inches		In grams
		1st yr.	2nd yr.	1st yr.	2nd yr			Top	Root	
Not Mulched.. .	$ .96	$ .16	$ .08	$ .20	$ 12	....	$1.52	11 604	11 520	10 386
Paper Mulched..	1 08	.16	...	..	.....	$ .34	1.58	11 598	11.440	11 391

The average weight, the root and top lengths were secured of 100 average and uniform trees on each plot. The cost of mulch paper per thousand trees was computed from the total cost of production, which included freight charges on the paper. In computing the amount of paper used, only six inches were charged to each row, for no matter how many rows are set out only one additional strip of six-inch paper would be used.

Table 1 shows that the increased cultivating and weeding costs for the check plot almost off-set the increase in cost of producing trees in paper. The increase in weight of 1.005 grams of the paper mulched over the check plot appears to have been in the roots, for the mulched transplants had a more bushyroot system.

The biggest problem in the use of paper is to keep it in place. A strong wind will blow it off if it is not properly anchored. To prevent this the ends and edges of the paper should be completely covered with one-half to three-fourths of an inch of soil. The ground under the paper should

have a convex shape in order to let rainwater get under the paper. If the paper has a concave surface, it will collect and hold the precipitation from light rains and this water will be lost by evaporation. The trees in this experiment, as is usual with transplants, were not watered; nevertheless, no severe loss occurred on either plot.

Tentative Conclusion

Paper mulching forest tree transplants in the nursery increases the total dry matter. However, this increase in weight is so small that the trees are not outstandingly superior in size as compared with non-mulched trees. Production costs for paper mulched trees are higher and would prohibit the use of paper in localities where cheap labor can be secured and where the transportation costs on the paper would be high. The reduction in paper costs from five dollars in 1929 to three dollars (the cost per roll in 1931) and the saving of ground area would make it practical and economical to produce transplants in paper at forest nurseries where ground space and labor are at a premium.

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COSTS OF FATTENING LAMBS IN 1930-31

D. H. LA VOI AND K. T. WRIGHT, SECTIONS OF ANIMAL HUSBANDRY AND FARM MANAGEMENT

During the 1930-31 lamb feeding season the Animal Husbandry and Farm Management Departments of the Michigan State College cooperated in a special study of lamb feeding. This study was designed to give information on what it costs to fatten lambs, to show any relationship existing between practices followed and results obtained, and to compare hand and self-feeding.

There were 29 feeders in central and southern Michigan that cooperated in the keeping of the necessary records. These men kept an account of the cost of the lambs, the amount and value of the feed fed, the time spent caring for the lambs, any other expenses, the receipts from the sale of the lambs and any other credits.

There were 21,158 lambs purchased by these men and they sold 20,642 or an average of 712 per farm. (See Table 1.) All of these were western lambs except some 1,765 "natives" that were fed on five farms. Seventy-five per cent of the feeders started feeding their lambs in the months of October, November and December. The average weight of the lambs at the start was 66.6 pounds. The lambs were kept an average of 97 days and were on

full feed 69 days. During this time they put on 20.4 pounds, so weighed 87 pounds when marketed. The lambs cost $7.18 a hundred at the farm, and brought $9.15 at the market when sold. The average marketing costs totaled 57 cents a hundred.

Table 1 shows that it cost 12.5 cents on the average to put on a pound of gain on the lambs in 1931. These feeders fed 5.8 pounds of grain, worth $1.12 a hundred to produce a pound of gain. In other words, the grain charge amounted to 6.6 cents and the roughage 3.2 cents for every pound of gain. Averaging the entire feeding period, there was 1.2 pounds of grain fed daily to each lamb. The total income amounted to 14.5 cents for each pound gain, so there was a profit of two cents for each pound put on the lambs.

Table 1.—Charges and credits per pound of gain on the lambs, 1930-31.

Items	Hand fed	Self fed	Average All
CHARGES:			
Grain	6.5¢	6.6¢	6.6¢
Roughage	3.8	3.0	3.2
Labor	.8	.7	.7
Use of buildings	.8	.9	.9
Use of equipment	.1	.1	.1
Interest on lambs	.5	.4	.5
Insurance	.1	....	....
Shearing	.1	.1	.1
Share of overhead	.3	.3	.3
Miscellaneous	.2	.1	.1
Total	13.2¢	12.2¢	12.5¢
CREDITS:			
Increase in lamb value	13.0	11.3	11.9
Lambs kept	....	....	....
Wool	1.2	1.3	1.2
Pelts	....	....	....
Manure	1.5	1.3	1.4
Total	15.7	13.9	14.5
Profit per lb. gain	2.5¢	1.7¢	2.0¢
NOTES:			
No. farms	17	12	29
No. lambs fed out	392	1165	712
Average weight at start (lbs.)	62.6	68.6	66.6
Gain per lamb (lbs.)	21.6	19.8	20.4
Total days on feed	111	76	97
Days on full feed	75	55	69
Cost at farm (per cwt.)	7.04	7.38	7.18
Sale price (per cwt.)	9.12	9.18	9.15
Value at farm (per cwt.)	8.55	8.62	8.58
Grain daily per lamb (lbs.)	1.1	1.5	1.2
Roughage daily per lamb (lbs.)	1.5	1.5	1.4
Grain per lb. gain (lbs.)	5.7	5.9	5.8
Grain cost per 100 lbs.	1.13	1.12	1.12
Hours labor per 100 lbs. gain	3.2	2.8	2.9
Loss in feeding period (per cent)	2.6	2.4	2.5

In Table 2 are shown the charges and credits per lamb instead of per pound gain. This shows that the purchase price of the lambs averaged $5.05 each. The cost of feed for each lamb for the feeding period was $2.00, and labor, use of buildings and equipment, interest and the like made up the remaining 55 cents. The total cost per lamb at marketing time was $7.60 and the lambs sold for $7.47 each but the other credits amounted to 53 cents making a total of $8.00 or a profit of 40 cents per lamb. This is above the cost of feed, labor and all other expenses.

Table 2.—Charges, credits and profit per lamb, 1930-31.

Items	Hand fed	Self fed	All farms
CHARGES:			
Lamb cost	$4.67	$5.23	$5.05
Grain	1 40	1.31	1.34
Roughage	.82	.59	.66
Labor	.18	.14	.15
Use of buildings	.18	.17	.17
Use of equipment	.03	.02	.02
Interest on lamb	.11	.08	.09
Insurance	.01	.01	.01
Shearing	.03	.02	.03
Share of overhead	.07	.05	.06
Miscellaneous	.03	.02	.02
Total	$7.53	$7 64	$7 60
CREDITS:			
Lamb sale	7.49	7 47	7.47
Wool	.26	.25	.25
Pelts	.01	.01	.01
Manure	32	.25	.27
Total	$8 08	$7 98	$8.00
Profit per lamb	.55	.34	.40
Income per lamb, less lamb cost, feed and interest	1.08	.77	.86

Hand and Self-Feeding Compared

A difference in opinion exists in the State as to the relative merits of hand feeding as compared to the self-feeding of lambs. Although both methods are used, there are some feeders who are now using self-feeders that once were listed in the hand fed group.

Each of these methods seem to fit into the condition under which the lambs are fed rather than as just a method in itself. When rush feeding is practiced the self-feeder is more common, and when a long slow feed is conducted hand feeding is the more common practice. The size of lambs may also determine, to some extent, the practice—as in this report, the hand fed lambs averaged 62.6 pounds when purchased as compared to 68.6 pounds for the self-fed group. A larger lamb seems to gain faster and can be placed on full feed in a shorter length of time. These lambs are often classed as "warmed up" because they had already been on a grain ration but not fattened.

Many of the hand feeders of lambs object to self-feeding because of the death loss. In this report we found that the average death loss of 2.6 per cent was higher in the hand fed group than the 2.4 per cent loss in the self-fed group. This is such a small difference that it should not be used as a conclusive proof as to relative death losses under these systems of feeding. Occasionally feeders in each group have heavy losses but these can often be attributed to the quality of lamb started with and to the difficulty of getting them on feed because of some digestive disturbance already existing before the lambs are received. It is also true that no two groups of lambs feed out exactly the same. Internal parasites may cause some losses and they are becoming more common, as the western lambs are now showing signs of infestation. One point in favor of hand feeding is that the amount of feed fed daily can be regulated, while in the self-fed lot this is hard to do. It is in this later group that death losses are usually most common at the end of the feeding period, especially when the lambs are carrying con-

siderable internal fat. The feeder, however, that watches the condition of his lambs carefully and always sells when they are ready for market, will avoid most of this loss. Some feeders try to lessen the amount of feed fed during the latter part of the feeding period but this often throws the lambs off and they lose their bloom.

There is a considerable difference in the ration fed in the state as lambs vary and the rations used in many cases must fit the needs of the particular lambs on hand. Many things account for this such as source, size, quality, previous feeding and handling of the lambs.

In general, lambs on self-feeders are fed differently than those fed by hand, but usually they are started about in the same way. For the first few days they are being accustomed to their new surroundings and are gradually

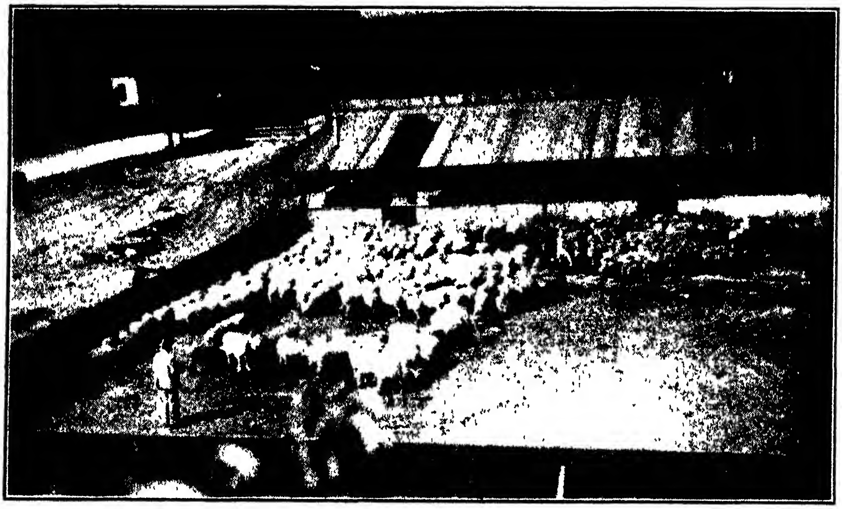

Fig. 1.—A self-fed lot of lambs. Plenty of barn and yard space should be provided for this system of feeding so the lambs will get sufficient exercise.

being placed on a grain ration. Pasture, hays and light grains are most commonly used at this time. After the lambs are on a full feed, it is more common to feed heavier rations in the hand fed lots, than when self-feeding is practiced. Heavy grains often cause severe death losses when placed in a self-feeder so lighter grains are more commonly used in this group. Some of the so-called lighter grains used in the State are flax chaff, black bran (a cereal by-product) screenings, salvage grains, common bran and some ground alfalfa. Oats is another common feed used by this group. Corn, barley and wheat make up a part of the ration but it is lightened by a combination of the above feeds. Some of the self-feeders in the state use heavy rations to good advantage with the claim that the increased gain makes up for the additional death loss which is likely to result.

The hand feeders, on the other hand, use a greater percentage of the heavier home-grown feeds as the quantity fed can be more easily regulated. Many different proportions are used and it would be hard to state a common ration used by all. This is evidenced by the fact that on a recent

feeder's tour, no two of the fifteen feeders visited used exactly the same ration. Rations used with success by some are thought impracticable by others.

Factors Associated with the Greatest Profits

The financial aspects of the two methods can be studied in detail from tables 1 and 2. It cost one cent a pound more to produce a pound of gain by hand feeding than self-feeding, but there was more margin between purchase price and sale price, consequently the "hand feeders" made 2.5 cents a pound profit and the men self-feeding 1.7 cents profit per pound gain. The 17 farmers hand feeding fed an average of 392 lambs compared to 1,165 per farm on the 12 farms where self-feeding was practiced. The feeders that hand fed bought lambs six pounds lighter than the 68.6 pound lambs purchased by the men self-feeding. Farmers hand feeding had their lambs 111 days while the other group kept theirs only 76 days, and the amount of gain was 21.6 and 19.8 pounds respectively. The rate of gain was one-fifth pound daily for the entire period for those hand feeding and one-fourth pound for those self-feeding. It required one-sixth more time to care for hand fed than self-fed lambs. Further comparison can be made in Table 2.

The ten feeders making the most profit on each pound of gain were selected out of the entire group and their results averaged to determine wherein they differed from the others. A comparison of this group with the average brings out the following points: (1) The average weight of the lambs at the start was about the same; (2) the high-profit group fed their lambs 11 days less and they weighed just one pound less when sold; (3) the lambs fed by the men making the most profit cost 15 cents a hundred more than the average, but they brought 40 cents more when sold; and (4) six of the ten men hand fed and four self-fed. These ten men made more profit because of slightly more gain per day and 25 cents a hundred wider margin due either to better feeding or marketing ability on the part of the feeder.

The ten lamb feeders having the highest return per lamb above the cost of the lamb, feed and interest were also selected out of the group for further study. These men fattened 397 lambs per farm compared to 712 as an average of all feeders. The lambs fed weighed over three pounds less at the start than the average, but weighed the same when sold even though fed the same length of time. The lambs fed by this group of ten men cost 13 cents a hundred less than the average and sold for 38 cents more. Six of the group hand fed and four self-fed. These ten men had an average return per lamb above the cost of the lamb, feed and interest of $1.58 compared to 86 cents for the average of all men, on account of more rapid gain, lower cost per pound of gain and 51 cents a hundred wider margin. In other words, the feeders having the highest return per lamb bought 63 pound lambs, fed them 96 days, and got .24 pound gain daily costing 11 cents a pound.

PRUNING THE PEACH

ROY E. MARSHALL, HORTICULTURAL SECTION

The Effect of Different Pruning Methods on Yields, Grades, and Returns for Gold Drop Peaches

Beginning with the spring of 1924, seven different pruning methods were employed each spring with a portion of a three-year-old block of Gold Drop peach trees at the Graham Horticultural Experiment Station near Grand Rapids. A preliminary report of the pruning work was published as a part of Michigan Special Bulletin No. 184 (pp. 14 to 22) and the results of another phase of the study appeared as Michigan Technical Bulletin No. 116. Each of these publications contains descriptions of the different pruning methods and photographs of trees subjected to the several treatments. This brief report attempts to present a general summary of the pruning weights from the time the trees were planted in 1921 and a summary of yields, grades, and returns from 1926 to 1930 when the stand of trees was such that the experiment was discontinued.

Severity of Pruning

Perhaps the most satisfactory method for determining the relative severities of pruning to which the different groups of trees were subjected is based on pruning weights. Table 1 gives the average annual pruning weights for the first, second, and third three-year periods and the total weights of prunings removed since the initiation of the pruning experiment in the spring of 1924. In addition to these weights, some wood of the current season's growth was thinned from the trees of Group C each June and a very small amount pinched from the ends of shoots of trees of Group E in the same

Table 1.—Average annual number pounds prunings removed from trees subjected to different kinds of pruning.

Treatment	1922–1924	1925–1927	1928–1930	Accumulative Total 1924–1930
A. Severe dormant pruning	2.4	10.8	16.2	85 4
B. No pruning	0	0	0	0
C. Moderate dormant pruning and summer thinning	1.9	8.7	9.4	57.8
D. Moderate dormant thinning	1.6	7.2	7.6	46.7
E. Moderate dormant pruning and summer pinching	1.4	8.4	8 5	53.3
F. Bulk pruning	1 6	6 4	8 1	46.1
G. Light dormant	1.0	6.6	5.9	38.9

month. The data show that the trees of Group A were pruned much more severely than those of any other group. The rank in descending order of the others is C, E, D, F, G, and B.

Figure 1 is designed to show more clearly the differences in severity of pruning treatments. Because of the tendency of the peach to produce much more wood in years of light crops than in years of heavy crop production which, in turn, results in heavier pruning following light crop years, very

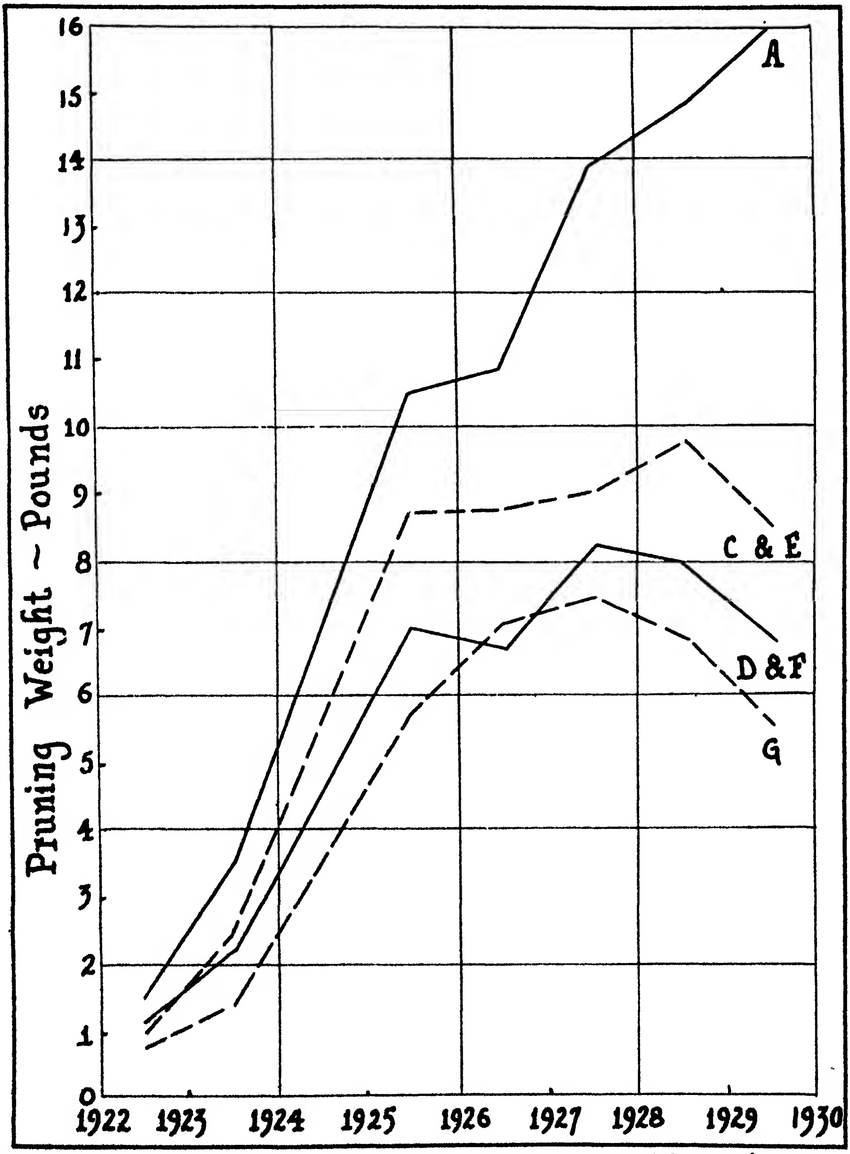

Fig. 1.—Graphs showing relative amounts of wood removed in pruning trees of the various groups during the nine years.

irregular or zigzag graph lines would result. These have been smoothed out to a considerable extent by averaging pruning weights for each two successive seasons. Since Table 1 shows the pruning weights of trees of groups C and E and of Groups D and F to be similar (though the treatments differed) the data from them have been combined and averaged, resulting in four rather than six graph lines in Figure 1.

Yields, Grades, and Returns

This orchard produced some fruit in 1925 (see Mich. Spec. Bul. No. 184). The first commercial crop was produced in 1926. There was no fruit in 1927. The succeeding three years were crop years. The yield data in this paper are therefore confined to the years 1926, 1928, 1929, and 1930.

Table 2.—Average yields per tree in pounds.

Treatment	1926	1928	1929	1930	Average
A. Severe dormant	63	102	91	41	74
B. No pruning	148	213	105	63	132
C. Mod. dormant and summer thinning	51	81	113	48	73
D. Mod. dormant thinning	131	153	134	85	126
E. Mod. dormant and summer pinching	63	97	76	60	74
F. Bulk pruning	99	155	148	75	119
G. Light dormant	70	132	137	90	107

Perhaps the most outstanding item in Table 2 is behavior of the trees receiving no pruning. They produced yields materially higher than the trees of other groups in 1926 and 1928 and then declined in yields to approximately the average of the groups. On the other hand, the trees that were pruned rather severely (Group A) and those that received summer treatments in addition to moderate winter pruning (Groups C and E) produced consistently low yields. For the four crop years, the trees of Groups D, F, and G gave yields significantly and consistently higher than the more severely pruned trees of Groups A, C, and E.

Table 3.—Average annual yields in pounds for various size grades for crop years.

Treatment	+2¼ ins	2-2¼ ins.	1¾ 2 ins.	−1¾ ins
A. Severe dormant	6	17	30	21
B. No pruning	0	5	45	82
C. Mod. dormant and summer thinning	3	15	28	27
D. Mod. dormant thinning	2	18	56	50
E. Mod. dormant and summer pinching	4	23	28	19
F. Bulk pruning	1	16	55	47
G. Light dormant	1	22	50	34

Table 3 shows that the unpruned trees produced only 30 per cent as many pounds of peaches larger than two inches as the next lowest yielding group (F) for this size grade, and that they produced materially greater yields of unmerchantable peaches than those of any other group. There were no significant differences in the yields of first grade fruit for the trees of other groups, though trees of Groups A, C, and E produced significantly larger yields of second grade (1¾ to 2 ins.) fruit and significantly smaller yields of unmerchantable (—1¾ in.) fruit than the trees of the other four groups.

There was a general tendency for the trees of all groups to decline in the production of peaches of the larger sizes and to increase in the production of small sized fruits with increasing age of the trees. This tendency to produce smaller quanities of fruits of the larger sizes with increased age was more pronounced with the more severe systems of pruning than with the unpruned and lightly pruned trees.

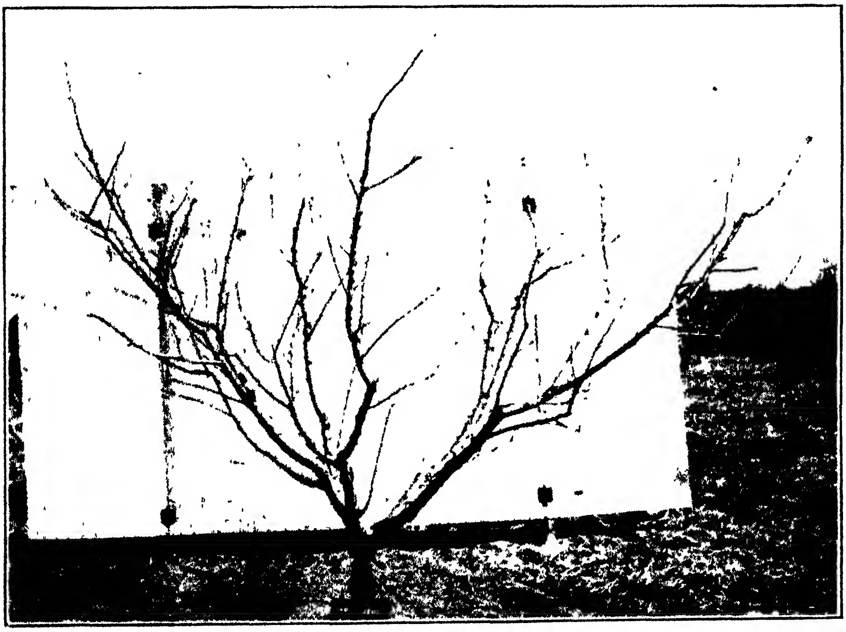

Fig. 2.—A typical six-year-old Gold Drop peach tree after receiving a severe dormant pruning consisting of both thinning and heading back. Photo taken in April, 1927.

The yields of fruit larger than two inches are low for all groups. This may be accounted for in part by the lack of fruit thinning. Furthermore, the Gold Drop variety tends to run to small sizes. It should also be stated that many trees of this orchard showed considerable black heart injury following the winter of 1926-1927.

The acid test of the desirability of any orchard practice is the net returns that are realized for the crop. The net prices used in computing the returns shown in Table 4 are the same as those used in an earlier publication (Mich. Spec. Bul. No. 184); fruit two inches or more in diameter is figured at

Table 4.—Annual and average annual net returns per tree for crop years.

Treatment	1926	1928	1929	1930	Average
A. Severe dormant	$1 35	$0 54	$1.18	$0.32	$1.10
B. No pruning	1.56	1.00	97	.00	.88
C. Mod. dormant and summer thinning	1.16	1.37	1.16	.10	.95
D. Moderate dormant thinning	1.86	2.08	1 61	.23	1.44
E. Mod. dormant and summer pinching	1 49	1.90	.93	.36	1 17
F. Bulk pruning	1.27	2 43	1 63	07	1 35
G. Light dormant	1.12	2 22	1.92	.49	1.44

$1.25 per bushel, that with a 1¾-2 inch diameter at $0.80, and fruit under 1¾ inches in diameter is figured as being practically unsalable and of no value. Thus, 62 per cent of the fruit produced by the unpruned trees had no market value while the trees given various pruning treatments produced 26 to 40 per cent unmerchantable fruit.

The data presented in Table 4 show that a continuous lack of pruning results in a marked decline in net returns per tree. Some pruning is necessary. On the other hand, rather severe pruning such as that afforded the trees of Group A results in comparatively low net returns because of low yields. The improvement in grade was not sufficient to counterbalance the decrease in yield where the trees were pruned heavily. The treatments that provided

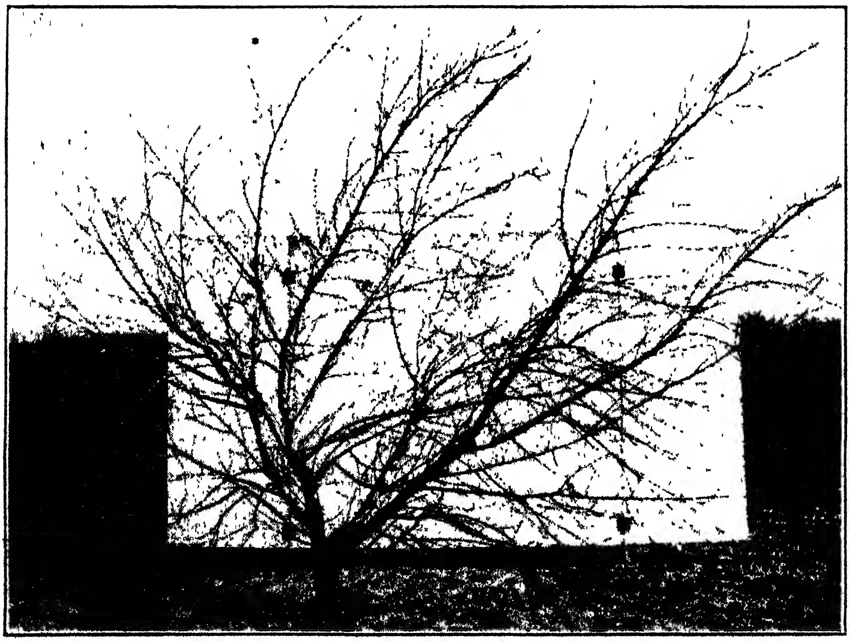

Fig. 3.—A typical six-year-old Gold Drop peach tree that has not been pruned for three years. Photo taken in April, 1927.

for a moderate dormant thinning out and heading back supplemented with summer pruning (Groups C and E) cannot be recommended on the basis of the data. The highest net returns were for the trees that were given a moderate dormant thinning (no heading) (Group D), those given a light dormant thinning out and heading back (Group G), and those in which a few cuts were made through branches two, three, and four years old (Group F). Figure 1 and Table 1 show that these three treatments were the least severe from the standpoint of amounts of wood removed in pruning.

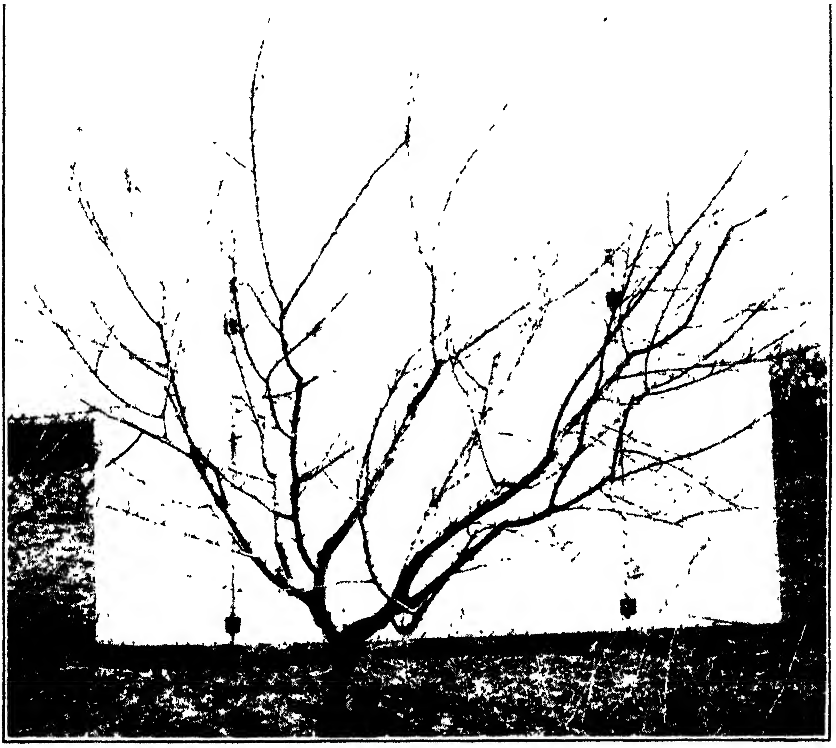

Fig. 4.—A typical six-year-old Gold Drop peach tree that has been a moderate amount of dormant season thinning each year but no heading back. Photo taken in April, 1927.

Discussion and Recommendations

Apparently, from the standpoint of net returns, it makes little difference whether the pruning consists of thinning out the shoots of the previous season, a combination of thinning out and heading back, or a thinning out of older wood provided it is well distributed. Some annual pruning must be provided but it may very easily be carried to the point where yields are reduced to such an extent as to reduce profits.

Pruning has two major functions in the peach orchard: (1) to train the tree, preventing fruiting wood from becoming too far removed from the

trunk and thus reducing losses from breakage of limbs, and (2) thinning the crop, thus influencing size of fruit and total yield. This paper deals primarily with the second function and indicates that it is not desirable to attempt to do all or even a large part of the fruit thinning by means of pruning. The first function, if given proper attention during the pre-bearing age, may be readily combined with the second provided a more severe treatment is occasionally practiced to bring the fruiting wood closer to the trunk.

Recommendations for pruning bearing peach trees may be summarized very briefly as follows: Give the trees a light to moderate annual pruning which may consist of thinning out or both thinning and heading back or possibly any other kind of light pruning that is well distributed through the tree and has a tendency to preserve or improve the form or shape of the tree from the standpoint of mechanical strength and facilitating other orchard operations. Then when there is no crop in sight, due to winter-killing of buds or spring frost injury, give the trees a rather severe heading back, cutting back into wood three or four years old, to bring the fruiting wood closer to the tree trunk, to reduce breakage, to keep the tree within bounds, and to increase shoot length or so-called tree vigor.

BULLETIN REVIEWS

Circ. Bull. 139.—"Tomato Diseases In Michigan."—Strong, M. C.—The symptoms of tomato diseases common in Michigan are described and control measures discussed. This bulletin is for the grower, its object being to furnish in condensed form information which will help to identify tomato diseases and to control or prevent them. Diseases common in the greenhouse are described as well as field diseases; the problems of the home gardener are also considered. (23 pages, 12 figures.)

Circ. Bull. 140.—"Home Production of the Family's Food Supply."—(Several staff members).—This bulletin sets forth what is required in the way of foodstuffs of various kinds in order to supply the average family with an adequate diet. This is followed by short articles explaining what is required in the way of land, equipment, and supplies in order to produce as large a proportion as possible of the required amounts of vegetables, fruits, potatoes, beans, eggs, meats and dairy products, thereby reducing the cash outlay for the family's food supply. (36 pages, 7 figures.)

Spec. Bull. 215.—"Successful Farm Practices in the Upper Peninsula." —Putnam, G. W.—Gives detailed information on the climatic and soil conditions of the Upper Peninsula. Discusses the crops suitable to these climatic and soil conditions, with recommendations as to variety and methods of culture, and the opportunities for livestock production, with a discussion of the successful practices of established herds and flocks. (69 pages, 43 figures, 17 tables.)

Spec. Bull. 217.—"Marketing Michigan Beans."—Hedrick, W. O.—Michigan beans, as a rule are marketed through a system which is similar to the marketing systems used for other farm products—local shippers,

wholesale handlers, one or two types of manufacturers and the retailers. They appear upon the final market fairly evenly proportioned as between dried beans and canned beans and are a standard grocery like rice or flour. The costs of distributing beans from the farm to the final consumer averaged during the decade 1921-1929, approximately 46.4 per cent of the retail selling price. (85 pages, 28 tables, 12 figures.)

Spec. Bull. 218.—"Spray Injury Studies. I. Injuries from Summer Applications on Apples."—Dutton, W. C.—Descriptions of several kinds of injury on the foliage and fruit of the apple, resulting from lime-sulphur, dry lime-sulphur, other sulphur materials, bordeaux and other copper compounds, and arsenicals and a discussion of some of the factors that favor the development of these injuries. Data from extensive experiments are presented to show the amounts of these injuries that occur and the effect of using various modifications to reduce the injuries. (68 pages, 21 figures—3 in color, 37 tables.)

Spec. Bull. 219.—"Spray Injury Studies. II. Secondary Effects of Spray Injury to Apple Foliage."—Dutton, W. C.—The set of fruit was not ordinarily affected but under unusual conditions or with excessive spraying the June-drop was sometimes excessive. Blossom bud formation is sometimes inhibited by injury to foliage and production of fruit may be reduced because of inadequate set or failure of the trees to form blossom buds. Premature dropping of the fruit just before harvest sometimes follows foliage injury and the development of desirable size and color in the fruit is checked. The diameter increment is lessened by injury to foliage. (38 pages, 17 figures, 25 tables.)

Tech. Bull. 118.—"Investigations In the Mosaic Disease of Bean (Phaseolus vulgaris L.)."—Ray Nelson.—A study of seed transmission of typical mosaic showed that the virus was distributed irregularly to the seeds in the various loci of the pod. In plants grown from diseased seed about one-half of the seeds become infected with the virus. An explanation based on the vascular anatomy of the pod is suggested for the peculiarities of seed transmission of the virus. In the cytological investigations cocci were demonstrated in the disintegrating chloroplasts of the parenchyma of petioles and leaves. They were also found in the parenchyma of phloem and xylem. It was not possible to demonstrate the cocci in all plants affected with mosaic and they were apparently localized in the tissues of the plants where they were found. By using a bean pod juice medium, cocci were isolated from the tissues of mosaic plants grown under sterile conditions and were obtained regularly in culture from young seeds removed aseptically from pods produced on primary infected mosaic plants. The number of seeds infected with the cocci appeared to be correlated with the number of seeds transmitting the virus. In plants infected during the growing season the number of infected seeds was fewer and in general corresponded to the fewer number of seeds receiving the virus in seasonally infected mosaic plants. From apparently normal field-grown plants of highly susceptible varieties, cocci were isolated occasionally also, but no cultures were obtained from the tissues of the same varieties grown under sterile conditions. A rugose type of mosaic on the Stringless Refuge variety differs from the typical mosaic and is possibly a distinct disease. A very pleomorphic bacterial organism was isolated from the young seeds of Refugee plants infected with rugose mosaic and it was demonstrated in the chloroplasts of the leaf parenchyma

of field-grown plants grown during the season of 1927. Bacteria of the same form were not found in plants grown subsequently but cocci and also Rickettsia-like organisms were isolated from young seeds with approximately the same frequency that cocci were obtained from the seeds of young pods from plants infected with typical bean mosaic. None of the organisms produced mosaic disease when young plants of susceptible varieties were inoculated by standard methods. (71 pages, 11 plates, 10 tables.)

Tech. Bull. 122.—"The Dissociation of Salmonella Pullorum and Related Species."—Mallmann, W. L.—A study of dissociation as measured by roughness and smoothness of colony formation was made on members of the Salmonella group, particularly *Sal. pullorum* and *Sal. gallinarum,* to determine the factor or factors responsible for induced changes. Three types of organisms as measured by fixity of colonial character, were used, namely stable R and S and intermediate forms. These three types of organisms were exposed to the following dissociation incitants: Brilliant green beef extract broth, rapid-transferring in a favorable medium, anti-R and anti-S immune serum, bacteriophage, passage through susceptible animals, aging at room temperature in nutrient broth and aging at ice box temperature for a two-year period. The results obtained show that stable R and S type organisms retain their original form with respect to colonial appearance irrespective of the incitant used. The intermediate types, on the contrary, were very susceptible to change. However, the changes induced were purely transitory, as the organism always regained its original form after it was returned to the usual stock medium. Single cell cultures of the three types behaved exactly as the pure-lime strains.

The following conclusions are presented:

1. Three types of organisms as concerns colony stability were found in the Salmonella group: stable smooth, stable rough, variable rough-smooth or intermediate.
2. Dissociation incitants were without effect upon stable rough and smooth type Salmonella organisms.
3. Dissociation changes occurred only in the intermediate type cultures.
4. Single-celled cultures behaved, under the influence of dissociating agents, exactly the same as the stock strains.

The data obtained seem to indicate that the colony types studied are of a hereditary nature and not merely environmental. (40 pages, 15 tables.)

Tech. Bull. 123.—"The Diagnosis of Brucella Infection In Animals and Man by Rapid Macroscopic Agglutination."—Huddleson, I. F.—Two methods have been described for preparing rapid antigen for detecting specific agglutinins in the blood serum of animals and man due to infections from *Br. melitensis* (Bruce), *Br. abortus* (Bang), and *Br. suis* (Traum). The technic of performing the rapid agglunination test on blood serum and whole blood and its interpretation is also presented. The experience that others have had with the test and its efficacy is presented in the review of the literature. (18 pages, 3 tables, 7 figures.)

JOURNAL ARTICLE ABSTRACTS

"The Alcohol Method for Determining Moisture Content of Soils."—Bouyoucos, G. J.—Soil Science. 32 (3): 173-179. 1931.—(Journal Article No. 59 (n.s.) Michigan Agricultural Experiment Station).—A method is

described for determining the moisture content of soils accurately and very rapidly by means of alcohol. The method consists of determining first the specific gravity of the pure alcohol, then mixing a definite amount of this alcohol with a definite quantity of soil, stirring the mixture thoroughly, filtering it and then determining again the specific gravity of the filtrate. By knowing the specific gravity of the pure alcohol and of the filtrate, the amount of water extracted from the soil can be easily calculated. Experimental results show that the method is almost as accurate as the dry oven method and that it can determine the moisture content of soil in from 5 to 12 minutes.

"Soil Maps As A Basis For Mapping Original Forest Cover."—Veatch, J. O.—Mich. Acad. Sci. Arts and Letters. 15: 267-273. 1931.—(Journal Article No. 62 (n. s.) of the Michigan Agricultural Experiment Station).—A detailed map of the original forest cover of Michigan would have not merely academic interest, but also would have direct significance in relation to problems of forestry and soil classification. The proposal is made by the author to reconstruct the original forest cover of the State on the basis of detailed soil maps, such as are currently being made by the U. S. Department of Agriculture and the Michigan Agricultural Experiment Station. A table of frequency based upon detailed mapping of cover is presented which indicates a fairly close correlation between soil types and types of vegetation in Southern Michigan. A difficulty appears because of the occurrence of a diversity of soils in small bodies; an assumption would have to be made that corresponding vegetational complexes existed.

"Effect of Heat at Varying Concentrations of Hydrogen Ion on Vitamin G (B_2) in Protein-Free Milk."—Halliday, N., with the assistance of Nunn, M. J. and Fisher, J. D.—Jour. Biol. Chem. 95 (1):371-385. 1932.—(Journal Article No. 70 (n. s.) from the Mich. Agr. Exp. Sta.)—The term vitamin G has been given to the factor (or factors) present in the vitamin B complex, which when fed to standardized test animals (rats) will induce gain in weight and prevent or cure a dermatitis condition which is induced by a diet deficient in the vitamin. This factor has been designated as the heat-stable member of the group of B vitamins, but the stability appears to vary with the time of heating, temperature, acidity or alkalinity of the medium and with the medium itself. Using yeast extracts as sources of the vitamin, the results from different laboratories indicate that the material may be heated 2 hours in a slightly acid medium (about pH 5) or 1 hour in a slightly alkaline one (pH 9) with very little loss; four hours heating in an acid medium (pH 2.5 to 6) caused 20—40 per cent loss, two hours at pH 8 to 9 caused 50 per cent loss while 4 to 5 hours at a higher alkaline concentration, (pH 10) caused nearly complete destruction. Autoclaving an extract of fresh ox liver at pH 9 caused about 75 per cent destruction, though there was no demonstrable loss of potency of an extract of commercial liver concentrate after similar treatment.

The present investigation was undertaken to determine the stability of the vitamin in protein-free milk. Using standardized albino rats as the experimental animals and a technique developed by Sherman and coworkers, the following results were obtained:

1. Heating 1 hour in an acid medium (pH 4.3) caused about 10 per cent loss of the vitamin, at about the neutral point (pH 7) there was 30 per cent loss, while in an alkaline solution (pH 10-8) the loss was approximately 40 per cent.

2. Heating these solutions 4 hours caused 30 per cent, 50 per cent and 75 per cent loss of potency, respectively.
3. Holding the solutions one week in the cold caused practically no loss of vitamin in the acid or neutral solutions, but at pH 10 fully 75 per cent of the vitamin potency was destroyed.
4. As a criterion of vitamin potency either (a) the growth made by experimental animals above that made by littermate negative controls during an 8-week experimental period, (b) growth of experimental animals during the first four weeks, or (c) during the 2nd to the 5th week of the experimental period may be used. Cure of dermatitis lesions could be used as a qualitative test only for the presence of the vitamin.

"*An Attempt to Prevent the Formation of Mycoderma Scums on Pickle Brine by the Use of a Mercury Vapor Lamp.*"—Fabian, F. W. and Bryan, C. S.—Fruit Products Journal and American Vinegar Industry. *11* (5): 134-137 1932.—(Journal Article No. 72 (n. s.) from the Michigan Agricultural Experiment Station).—A study was made of the influence of irradiation on pickle scums yeasts with a view of preventing and controlling their formation. The experimental results showed that the strains of mycodermas studied were as susceptible to ultra-violet radiation as *Escherichia coli* or *Eberthella typhi.* Young cultures (1 day old) of mycodermas were relatively more resistant to ultra-violet radiation than old cultures (7 days old). The length of time necessary to sterilize the scum or film produced on pickles generally depends upon its thickness. The yeasts which grew rapidly and produced an abundant growth formed a deeper film. As a rule the ultra-violet radiation was not as effective in killing the cells found in the deeper layers. There is considerable variation between different strains or species, irrespective of their age or the thickness of film, in their resistance to ultra-violet radiation; some strains were readily killed while others survived for varying periods of time ranging from 2.5 to 20 minutes.

"*Studies on the Dispersion Procedure Used in the Hydrometer Method for Making Mechanical Analysis of Soils.*"—Bouyoucos, G. J.—Soil Science. 33 (1): 21-26. 1932.—(Journal Article No. 73 (n. s.) from the Michigan Agricultural Experiment Station.) The hydrometer method of making mechanical analyses of soils was further investigated by comparing its mechanical stirrer with the standard shaker for dispersing soils. It was found that 10 minutes' stirring with the mechanical stirrer produced about the same degree of dispersion as 16 hours' shaking with the standard shaker. Treating soils with hydrogen peroxide did not affect their mechanical analysis as measured by the hydrometer method, except in soils that contain very large amounts of organic matter, especially of the undecomposed type. On account of its efficiency, the mechanical stirrer tends to break down the sand particles on long stirring; hence it is advisable not to stir the sandy soils too long. The extreme rapidity with which the hydrometer method is able to measure the mechanical analysis of soils is not due, therefore, to their incomplete dispersion. Further research and comparison tend to support the original findings that, for all practical purposes, the hydrometer method is reasonably accurate and reliable.

"*Further Studies on the Relationship Between the Fine Material of Soils and Their Physical Characteristics.*"—Bouyoucos, G. J.—Soil Science. 33 (1): 27-38. 1932.—(Journal Article No. 74 (n. s.) from the Mich.

Agr'l Exp. Sta.).—A study was made to ascertain whether there are close relationships between the "total colloids" clay, and fine clay of soils as determined by the hydrometer method, and certain consistencies of soils such as the crumbling point, flowing point and upper plastic limit. The idea underlying this investigation was that, if there do exist such close relationships, then the consistencies and other soil physical properties can be indirectly determined very quickly and simply and probably more accurately by means of the hydrometer method.

From the results obtained coefficients of correlation were worked out, and these in turn were reduced to the percentage basis. The coefficients of correlation on the soils studied show that the variability of the crumbling point is controlled 93.3 per cent by the "total colloids," 88.93 per cent by the clay, and 85.0 per cent by the fine clay. The variability of the flowing point is controlled 84.8 per cent by the "total colloids," 82.1 per cent by the clay, and 83.7 per cent by the fine clay. The variability of the upper plastic limit is controlled 83.9 per cent by the "total colloids," 83.5 per cent by the clay, and 84.6 per cent by the fine clay. The variability of the moisture equivalent is influenced 82.7 per cent by the "total colloids," 80.1 per cent by the clay, and 80.5 per cent by the fine clay. No definite relationship could be established between the chemical composition of the fine material of soils studied and their physical properties studied. Undoubtedly there may be some types or individual soils which will not show as good correlation between the fine material and physical characteristics as revealed in soils studied here. From the correlations obtained it would seem that the hydrometer method can be employed to obtain indirectly and quickly certain physical characteristics of soils.

"*Observations On Prolapse* (*Blow-outs*).—Stafseth, H. J., Thompson, W. W., and Gray, C. G.—Jour. Am. Vet. Med. Assoc. 80 (n. s. 33) (1): 80-86. 1932.—(Journal Article No. 82 (n. s.) from the Mich. Agr'l Exp. Sta.).—This work was carried out for the purpose of determining the cause of prolapse and allied ailments such as so-called "blow-outs" and "pick-outs." Eighty-six adult birds and 20 chicks were examined. Fifty per cent of these birds showed roundworm and 13 per cent tape worm infestation. Marked intestinal inflammation was found in 45 per cent of the birds. Observations showed that continued straining is a common manifestation in birds just prior to prolapse or eversion of the cloaca and that prolapse of the cloaca and the oviduct is more common than prolapse of the oviduct alone. Attempts at finding a microbe that might be responsible for this malady failed. It also seems unlikely that it is of nutritional origin since all efforts at reproducing it artificially by changes in the ration have met with failure. At present it seems as if intestinal inflammation, resulting in irritation and straining may be responsbile for some of this trouble. In one flock almost immediate elimination seemed to result from treatment with "Iodine Vermicide" which was given to remove roundworms and tapeworms thought to be responsible for intestinal inflammation prevalent in this flock.

"*The Effects, Treatment and Prevention of Worm Infestation In Poultry.*"—Stafseth, H. J. and Thompson, W. W.—Jour. Am. Vet. Med. Assoc. 80 (n. s. 33) (3): 467-473. 1932.—(Journal Article No. 83 (n. s.) from the Michigan Agricultural Experiment Station).—The symptoms of worm infestation are: failure to grow, to feather out, to come into production or

to stay in production; emaciation; paleness; dry and shriveled, sometimes cyanotic combs and wattles; rough plumage; untimely molting; lack of gain in weight or condition in proportion to the feed consumed; lack of appetite; lameness; perhaps even paralysis and blindness; diarrhea, straining, prolapse of cloaca and death. Changes in the tissues are usually limited to the intestinal tract where inflammation of various degrees may be found. One tapeworm may cause tissue changes resembling intestinal tuberculosis. The large roundworm causes shrinking of the thymus gland and a decrease of blood sugar—"Iodine vermicide" was used in treating 29 birds which were kept in individual cages under which were pans for collecting expelled parasites. Iodine appeared in the droppings 10-15 minutes after administration. On autopsy of the treated birds it was found that worms may be killed by "Iodine vermicide" in 15 minutes. This remedy is practically 100 per cent effective against the common roundworm of chickens and, when properly administered, shows a very high degree of efficiency in removing tapeworms. Birds treated with "Iodine vermicide" show no ill effects therefrom. Ordinary sanitary measures aiming at removing discharged worm eggs and intermediary hosts of tapeworms such as flies, slugs, etc., should also be employed in control of worm infestation.

"The Control of Cherry Case-Bearer, Coleophora Pruniella, by Dormant and Other Sprays."—Hutson, R.—Jour. Econ. Entom. 25 (1): 116-120. 1932.—(Journal Article No. 89 (n. s.) from the Michigan Agricultural Experiment Station).—Cherry Case-Bearer, *Coleophora pruniella,* the pest inflicting damage on cherry, particularly in Grand Traverse county, although distributed through other counties in the northern cherry belt, is susceptible to control by dormant applications of rather high concentrations of oil emulsions, miscible oil, and two washes. Various standard brands of materials applied according to manufacturers directions, together with homemade oil emulsions containing 6 per cent actual oil, show that control above 90 per cent can be obtained by applications in the dormant season. It is also shown that various combinations of nicotine and Derrisol combined with the regular lime sulphur sprays put on cherries in the fungicidal sprays going on at the time the casebearers are first feeding on the leaves, can be used effectively as an emergency measure. Further experiments disclosed rather poor control of lead arsenate sprays for casebearers.

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264 Second Report of Grade Dairy Herd.
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286 Studies and Cost of Milk Production—No. 2.

Special Bulletins—

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MICHIGAN AGRICULTURAL EXPERIMENT STATION QUARTERLY BULLETIN
Vol. XV, No. 2, November, 1932

EXPERIMENTS WITH PERMANENT PASTURES FOR SHEEP

A. B. DORRANCE, G. A. BROWN, AND H. C. RATHER, SECTIONS OF ANIMAL HUSBANDRY AND FARM CROPS.[1]

That alfalfa has many advantages as a pasture for dairy cows was indicated in results of the 1931 pasture trials at the W. K. Kellogg Farm of the Michigan State College reported in an earlier edition of this publication.[2]

The possibilities of using alfalfa advantageously as a pasture for sheep have also been brought out in experiments at the W. K. Kellogg Farm. These experiments were begun in 1929 in an effort to determine the best means of providing adequate pasture on rather worn out sandy soils of which the area chosen for these experiments is typical.

A Sandy Loam Soil Used

The soil used is classified as Bellfontaine sandy loam. It is described by Deeter and Trull[3] as having a surface layer, about two inches thick, of dark grayish-brown sandy loam or fine sandy loam and leaf mold. This is underlain, to a depth of six inches, by grayish-brown sandy loam containing some small gravel. In cultivated areas, these layers are mixed giving the surface soil a grayish-brown color. Between depths of about six and 14 inches is a layer of yellow sandy loam which becomes a little lighter yellow at a depth of about 10 inches. Beneath this layer, and continuing to a depth of about 26 inches, is a layer of reddish-brown coherent sandy clay which is sticky when wet. This is underlain by loose sand, gravel, and bowlders. Some limestone, and, in places, small quantities of clay are present in this material.

This soil is acid throughout the first four layers but is alkaline below this. It does not retain a very large supply of moisture, and during a drought crops may suffer. The productivity is comparatively low. The soil is not very durable and will soon wear out if organic matter is not returned frequently.

Barnyard manure and green manures are the only fertilizers used to any extent on this soil, although a quick response is shown when commercial fertilizers are applied.

Most of the 14 acres in the area used for the experiment was covered

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[1]Pasture experiments are carried on at the W. K. Kellogg Farm of the Michigan State College cooperatively between the Division of Forage Crops and Diseases, Bureau of Plant Industry, United States Department of Agriculture, and the Section of Farm Crops of the Michigan Agricultural Experiment Station. Mr. Dorrance is Assistant Agronomist, Division of Forage Crops and Diseases.

[2]Dorrance, A. B. and Rather, H. C. Experiments With Alfalfa As A Pasture For Dairy Cows. Mich. Exp. Sta. Qtr. Bul., Vol. XV, No. 1. 1932.

[3]Deeter, E. B. and Trull, F. W. Soil Survey Barry County, Michigan. U. S. D. A. Soil Survey Series.

Table 1.—W. K. Kellogg Farm Permanent Pasture Trials. Record of Seedings and Treatments, 1929-32.

Crop	Seeding		Lime per acre 1929 only	1929		1930			1931 Fertilization	1932 Fertilization
	Kind	Rate, lbs. per acre		Fertilization	Results	Seeding	Fertilization	Result		
1. Alfalfa	Grimm	10	7 yds. marl	300 lbs. per acre 2-12-6	Seeding failed—drought	Reseeded	300 lbs. 2-12-6	Seeding established	None	300 lbs. 0-14-14
2. Pasture Mixture 2 Nitrogen Applications	Kentucky Bluegrass Canada Bluegrass Red Top Timothy Alsike June Clover White "	6 3 3 4 2 2 2	7 yds. marl	300 lbs. per acre 2-12-6 100 lbs. nitrate of soda applied in early July	Seeding failed—drought	Reseeded	300 lbs 2-12-6; 100 lbs. nitrate of soda in early July	Seeding established	100 lbs. sulphate of ammonia in spring. 100 lbs. cf nitrate of soda in early July	300 lbs. 0-14-14; 100 lbs. sulphate of ammonia; 100 lbs. nitrate of soda in early July
3. Pasture Mixture One Nitrogen Application	Same as No. 2	Same as No. 2	7 yds. marl	300 lbs. per acre 2-12-6	Seeding failed—drought	Reseeded	300 lbs. 2-12-6	Seeding established	100 lbs. sulphate of ammonia	100 lbs. sulphate of ammonia; 300 lbs. 0-14-14
4. Unfertilized Pasture Mixture	Same as No. 2	Same as No. 2	None	None	Seeding failed—drought	Reseeded	None	Seeding established	None	None
5. Fertilized Sod	None	None	7 yds. marl	300 lbs per acre 2-12-6	Pastured—no records	None	300 lbs. 2-12-6	Cut for hay	100 lbs. sulphate of ammonia	100 lbs. sulphate of ammonia; 300 lbs. 0-14-14
6. Unfertilized Sod	None	None	None	None	Pastured	None	None	Cut for hay	None	None
7. Sweet Clover	Biennial White Blossom	15	7 yds. marl	300 lbs. per acre 2-12-6	Seeding failed—drought	Reseeded	300 lbs. 2-12-6	Seeding established	None	300 lbs. per acre 0-14-14 Reseeded

NOTE:—An attempt was made to reseed sweet clover with itself in 1931 which failed, thus sweet clover afforded no grazing in 1932.

with a sod composed of Canada bluegrass and timothy with an occasional crown of alfalfa.

It was planned to measure the value of different pastures by grazing them with sheep. Accordingly, 14 one-acre paddocks were laid out and seven different pasture treatments were made in duplicate. Table 1 gives the record of these treatments since 1929.

Drought Takes 1929 Seedings

Little can be reported for the seasons of 1929 and 1930. Summer seedings made in 1929 encountered severe drought and failed. With the exception of clovers sown in the mixtures, spring seedings made in 1930 were sufficiently established before the drought of that season so they survived. It is significant that natural sod gave immediate response to fertilization and was available for grazing in 1929 and 1930 when seedings on the tilled areas were being established and was far more economical than the seeded grass mixtures.

The 1931 results deserve some comment. Although it was necessary to measure returns with a breeding flock of both ewes and their lambs, noteworthy differences in carrying capacity were apparent. These are given in Table 2.

Table 2.—W. K. Kellogg Farm Permanent Pasture Trials—1931. [1]Sheep-Days Pasture per acre by months and gain in pounds per acre.

Crop	Sheep-Days of Pasture Secured (2)					Pounds gain per acre
	June	July	August	September	Total	
Alfalfa	242 7	196 5	93 0	81 0	613 25	214 56
Fertilized Sod	169 2	173 7	140.5	117 0	608 5	130.17
Sweet Clover	135 5	207.5	None	None	343 0	98 76
Pasture mixture, 2 nitrogen applications	175.7	162 0	110 5	104 0	552 25	84 01
Pasture mixture, 1 nitrogen application	94.5	123 5	116.5	44 0	378 5	37 25
Unfertilized Sod	54 0	89.5	78.0	None	221.5	54 75
Unfertilized pasture mixture	87.7	77.0	42 5	None	207 25	23 43

(1) A sheep-day in this table is considered pasturage for one mature sheep for one day Two lambs were considered equivalent to one mature ewe on the average.
(2) All data given represent the average of the two duplicate plots.

Alfalfa Pasture Outyielded Sweet Clover

Sweet clover has attained widespread popularity as a pasture crop. In this experiment, it was exceeded in value and carrying capacity by alfalfa all season long. As is characteristic of sweet clover, it ceased to be desirable for pasture as it reached maturity in late July and it afforded no grazing when badly needed in August. Another comparison of sweet clover with alfalfa for spring and early summer grazing will be watched with interest in 1933.

The fertilized sod gave much more grazing and better gains than the seeded mixture similarly fertilized. All of this difference, however, cannot be considered typical since there was a liberal mixture of alfalfa in the old sod of one of the paddocks. This disappeared during the season and winter 1931-32, perhaps due to the preference of the sheep for the alfalfa in the mixture, since they kept it grazed into the ground all summer, and to fertilization with ammonium sulphate, favorable to the grasses but unfavorable to alfalfa.

A difference more in line with expectations existed between unfertilized sod and the unfertilized pasture mixture seeding. The old sod held any real advantage which existed and was, of course, much the cheaper pasture since no seed bed preparation, seed nor seeding costs were incurred.

The pasture mixture with the extra nitrate of soda application in midsummer carried a greater load than that receiving only the spring nitrogen application (100 lbs. per acre of sulphate of ammonia). Since this advantage was much more apparent in the spring than in the summer it would appear that it is due to the extra fertilization of the previous season. This treatment also resulted in a greater recovery of the grasses with September rains.

1932 Results Measured with Western Lambs

In 1932, 100 Texas sheep were used to measure grazing returns from the various treatments. Fifty of these were late black-face lambs and the other 50 were early yearlings carrying more fine wool breeding. With much more abundant rainfall, the pastures did better than in any previous season and the 100 Texas lambs couldn't hold their own with the rapidly growing grasses and legumes so a portion of the farm flock of Shropshire ewes and lambs was again called into service. By June 27, all Shropshires had been removed to other pastures. On July 5, the Westerns were reallotted to the plots and started on a daily ration of barley in addition to their pasturage.

1932 results are summarized in Table 3. The price of 5.5 cents per pound for weight increase represents an estimated average value. As a matter of fact, the Western lambs brought $6.25 per cwt. on the Detroit market in early September and the fine-wool yearlings sold for $4.50 per cwt. Since the spring gains were on high class native Shropshire lambs, 5.5 cents per pound is assumed to be a fair average value for all gains made throughout the season.

Gains made by the Western lambs, especially after July 5 when they received grain as well as pasturage, were not as good as they should have been. These sheep were drenched for worms and dipped for external parasites once near the start of the grazing season. Undoubtedly, better results would have been secured had they been drenched for internal parasites each month.

Another difficulty in the experiment is the impossibility of estimating accurately the exact carrying capacity of a plot for a given number of days. For that reason, a large number of lamb-days pasture was sometimes secured at the expense of slow gains or an actual loss in weight.

The pasture unit used in 1932 was the lamb-day. The Western lambs ranged in weight from 40 to 65 pounds at the beginning of the experiment. The Shropshire ewes, nursing lambs, which were used in the beginning of the experiment weighed 100 to 180 pounds and for purposes of comparison are considered as equivalent to two of the Westerns. Sheep-days in the

1931 trials are not to be compared with lamb-days in the 1932 trials, except in a relative way. The results from a treatment in a given season are comparable only with the results secured from other treatments that same season. The best we can hope for in a grazing experiment is that specific records coupled with careful observation will establish important trends and differences which will serve as a guide in problems of pasture management.

Alfalfa Profitable As Pasture

The outstanding fact gained from the 1932 trials is that alfalfa pasture as grazed by these sheep is the only one to return a worthy margin above feed and fertilizer costs. The net returns from the alfalfa used as sheep pasture are well worth while and undoubtedly better than they would have been from alfalfa cut for hay and used as a cash crop at 1932 hay prices.

Fig. 1.—Western lambs on one of the alfalfa paddocks.

In intensive dairy management or on better soils, the fertilization of grass pastures may pay. In this experiment, it did not and it is doubtful whether fertilization of permanent grass pasture for sheep on the kind of land used in this experiment can be profitable under present economic conditions.

Fertilizer Improves Ground Cover of Grass Pastures

The applications of fertilizer on the grass pastures did increase the yield. Both sets of the fertilized pasture mixtures have increased in ground cover and changed materially in type of vegetation since 1930. In 1931, timothy was the predominating grass in these paddocks, but there was considerable redtop, some Canada bluegrass, and more Kentucky bluegrass. In 1931, the unfertilized pasture mixture was chiefly timothy and redtop with traces of the bluegrass showing. In 1932, the mixture receiving two nitrogen applications per year was chiefly Kentucky bluegrass with traces of Canada

Table 3a.—W. K. Kellogg Farm Permanent Pasture Trials—1932. Lamb-days pasture per acre and gains in pounds per acre by periods. (Average of duplicate one-acre plots.)

Crop	No grain fed. Pasture days measured with both western lambs and native sheep (1)						Barley fed daily. Pasture days measured with western lambs only							
	May 20 to June 4		June 4 to June 20		June 20 to July 5		July 5 to July 20		July 20 to Aug. 4		Aug. 4 to Aug. 19		Aug. 19 to Aug. 27	
	Lamb-days per acre	Gain, pounds per acre	Lamb-days per acre	Gain, pounds per acre	Lamb-days per acre	Gain, pounds per acre	Lamb-days per acre	Gain, pounds per acre	Lamb-days per acre	Gain, pounds per acre	Lamb-days per acre	Gain, pounds per acre	Lamb-days per acre	Gain, pounds per acre
Alfalfa	284.5	23.4	467.0	261.2	283.0	−33.2	240.0	55.0	240.0	38.0	235.0	18.7	124.0	29.2
Pasture mixture, two nitrate applications	141.0	37.3	531.0	123.0	165.0	6.7	150.0	42.5	150.0	19.5	150.0	24.0	80.0	6.3
Fertilized Sod (3) . .	120.0	49.5	128.0	31.5	132.0	18.0	90.0	38.5	90.0	14.5	90.0	19.5	48.0	8.0
Pasture mixture, one nitrate application . .	131.0	46.0	282.0	86.5	363.0	−65.5	97.5	27.2	97.5	3.0	97.5	23.7	52.0	1.7
Unfertilized Sod . . .	60.0	28.0	67.0	24.0	67.5	15.0	75.0	6.5	75.0	17.5	75.0	8.7	40.0	−0.2
Unfertilized pasture mixture	60.0	19.1	67.0	20.7	75.0	7.7	75.0	4.0	74.5	12.5	74.5	14.2	36.0	7.7

(1) In determining lamb-days for this period one native Shropshire ewe was considered the equivalent of two westerns.

(2) Result of one plot only. The duplicate became infested with Downy brome grass (Bromus tectorum) and was not comparable to normal fertilized sod in vegetation.

Table 3b.—W. K. Kellogg Farm Permanent Pasture Trials—1932. Total lamb-days pasture and gains per acre and relative acre returns. (Average of duplicate one-acre plots.)

Crop	Totals for period May 20 to July 5, using both western and native sheep without grains(1)		Totals for period July 5 to Aug. 27 using western lambs only and feeding grain		Totals for entire season		Average pounds gain per lamb per day	Total pounds of grain fed per acre	Pounds grain consumed per lamb per day	Value of barley consumed, per acre of pasture, at 30 cents per bushel	Total value of gains at 5.5 cents per pound	Acre returns from pasture less cost of grain	1932 fertilizer charges (5)	Returns after deducting grain costs and 1932 fertilizer charges
	Lamb-days per acre	Gain, pounds per acre	Lamb-days per acre	Gain, pounds per acre	Lamb-days per acre	Gain, pounds per acre								
Alfalfa	1034 5	251.4	839 0	140 9	1873.5	392.3	21	1028	1 23	$6 42	$21 58	$15 16	$4 83	$10 33
Pasture mixture, two nitrate applications	837 0	167 0	530 0	92 3	1367.0	259.3	19	643	1 21	$4 02	$14 26	$10 24	$9 07	$1.17
Fertilized Sod(2)	380 0	99 0	318 0	80 5	698.0	179.0	26(3)	370	1 16	$2.31	$9.85	$7 54	$8 02	$ −0.48
Pasture mixture, one nitrate application	776 0	67 0	344 5	55 6	1120.5	122.6	11(4)	413	1 20	$2 58	$6.74	$4.16	$8 02	$ −3 86
Unfertilized Sod	191 5	67 0	265 0	32 5	456.5	99.5	22	298 5	1 13	$1 87	$5 47	$3 60	none	$3 60
Unfertilized pasture mixture	199 0	47 5	260 5	38 4	459.5	85.9	19	280	1 07	$1 75	$4 72	$2.97	none	$2 97

(1) In determining lamb-days for this period one native Shropshire ewe was considered the equivalent of 2 westerns.
(2) Result of one plot only. (See footnote 2, table 3a.)
(3) The data apparently indicate that this plot was not stocked as heavily in comparison to its vegetation as the others rather than any superiority in quality.
(4) Undoubtedly stocked too heavily June 20 to July 5
(5) Fertilizer charges made against 1932 returns are all costs of nitrate applied in 1932, 60% of the 0-14-14 applied in 1932, and 1/3 of the 2-12-6 applied in 1930, all other fertilizers previously applied are chargeable to previous seasons.

bluegrass and probably 10 per cent each of timothy and red top; the mixture receiving but one application of nitrogen per year had much less Kentucky bluegrass, a little more Canada bluegrass and a lot more timothy and redtop. The unfertilized plots which had been seeded to the pasture mixture were covered, in 1932 by a very thin turf of redtop, some Canada bluegrass, and a heavy growth of red or sheep sorrel (*Rumex acetosella*). Of the three clovers, June, Alsike, and White, sown in 1930, none had shown up since the following winter until the relatively moist summer of 1932 when some white clover appeared in the fertilized pasture mixture plots which received but one nitrogen application.

The fertilized sod plots, originally had some timothy and a trace of alfalfa, but these species have disappeared leaving only Canada bluegrass on the one plot and an infestation of Downy brome grass along with Canada bluegrass on the other. On the unfertilized sod plots, the scattering of timothy and alfalfa in the Canada bluegrass sod has been replaced chiefly by red sorrel.

Alfalfa Has Greatest Carrying Capacity

Alfalfa pasture had the greatest carrying capacity, held up best during the summer, returned the greatest total gains, and was the least expensive of all plots receiving any fertilization. In the early part of the season, gains on alfalfa were somewhat irregular, to be sure. As the second growth started in late June with abundant moisture, its lush growth probably had enough of a laxative effect on the sheep to cause the loss noted on July 5th weighing. After that date, gains on alfalfa pasture were fairly steady and a higher percentage of lambs at the conclusion of the experiment on August 27 were fat and in marketable condition than from any other pasture.

It is of interest to note that at the termination of the experiment for the 1932 season, 56 of the yearlings and lambs not yet considered in prime condition for the market were turned into a large alfalfa meadow and continued on the barley. Four weeks later, they had gained .24 pounds per lamb per day.

Precautions Used Against Bloat

When pasturing alfalfa with sheep or cattle is considered, the question of bloat is frequently raised and some instances of the loss of animals on alfalfa pasture by bloating have come to our attention this season. The precautions taken with the Western lambs in this experiment were that after arrival, while being weighed on three successive days at the beginning of the experiment, they were kept on dry alfalfa hay and grass pasture. They were given a feed of hay in the morning and turned on to the alfalfa with this full feed; water and salt were available in the paddocks at all times, and the lambs were never taken out day or night, so they never had a chance to get hungry and overfeed on succulent alfalfa.

Although the 1932 season was one of abundant rainfall and although a portion of these lambs were on alfalfa pasture during heavy dews and some white frosts of September, no losses from bloating occurred. During the experiment, four unthrifty lambs died, one on alfalfa and three on grass pasture. In none of the cases did it appear that bloating was the cause.

In all cases of bloat of sheep or cattle which have come to our attention this season, the animals had been off the alfalfa pasture for some reason long enough to get hungry and it seems very evident that overeating was the real cause of the trouble. In our opinion, the precaution to be observed is

not one of keeping livestock off alfalfa at certain times, but rather one of keeping them on alfalfa constantly once the grazing of this crop has been started. This necessitates water and salt in or very near the pasture field. These are the precautions observed on the Michigan State College farm at East Lansing with dairy cattle, beef cattle, and sheep and on the W. K. Kellogg Farm with dairy cattle and sheep; and, although alfalfa has been pastured in every month from May into December, no serious difficulties from bloating have ever resulted.

Grass Pastures Inadequate in Dry Weather

The criticism of permanent grass pastures on such droughty soils as the Bellfontaine loams and sandy loams of this experiment are that they are in-

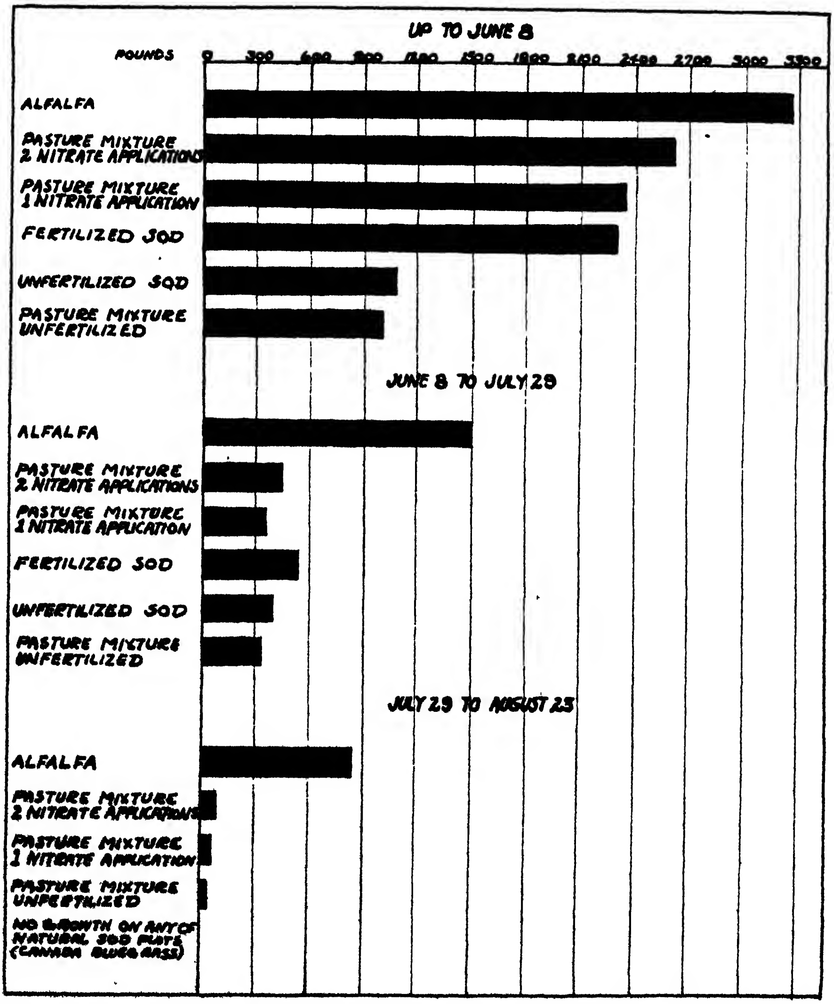


Fig. 2.—W. K. Kellogg Farm Permanent Trials. Air-dry forage production by periods—1932.

adequate. The grasses and other vegetation that will grow on this soil without fertilizer are relatively unpalatable and unproductive; when fertilization of these grasses is practiced the returns, though marked, are likely to cost too much.

Fertilization has not put summer stretch into these grass pastures. When dry weather begins, the fertilized plots quit just about as quickly as the unfertilized ones. This is especially evident in Figure 2 illustrating the air dry forage yields from these paddocks as represented by the mechanical harvest of uniform areas in each.

Even where nitrogen was applied in July, the yield response was not in July and August when it was most needed, but it came in the fall and spring when there was moisture.

Under the natural soil and climatic conditions of this area, the use of commercial fertilizer is likely to result in marked yield increases in May and early June when moisture is abundant, much of this increase going to waste because if enough livestock were kept to consume it, a pasture famine would exist on the farm in July and August.

Grass pastures on light soil may have their place on some of the untillable areas but, if used to greatest advantage, they will have to be supplemented by summer pasture from such drought resistant crops as Sudan grass or alfalfa. Other methods of improving permanent grass pastures on this type of soil will be attempted in future experiments.

The harvest of representative areas of alfalfa for air-dry forage yields indicates that the crop would have yielded approximately 2¾ tons of hay per acre. At $6.00 per ton, a fair cash crop price this season for alfalfa hay at the farm, the gross acre income from the alfalfa would have been $16.50. To get this income would have entailed the hazards, costs, and labor of harvest. The lambs returned $15.16 with no harvest labor and much lower handling and marketing costs. From this, it is apparent that when the hay needs of a farm are satisfied with the proper acreage of alfalfa there is still room for expansion in acreage of this valuable legume, the surplus being marketed, with but little labor or expense, as pasture for the right kind of livestock.

A NEW PEST ON RASPBERRY

RAY HUTSON, SECTION OF ENTOMOLOGY

During the growing season of 1931, red raspberries, under observation at the Agricultural Experiment Station farm, East Lansing, showed a type of injury which resembled the work of the red-necked cane-borer, but, on closer examination, exhibited symptoms which were different. Inasmuch as this was a new planting, set in the spring of 1931, the character of the injury was not studied further than to make a note that the same planting should be kept under observation in 1932.

During June, 1932, numerous Buprestid (boring) beetles of the genus *Agrilus*, and tentatively identified as *A. communis* variety *rubicola*, were collected on the leaves. Beetles of this same species were bred from *Rosa*

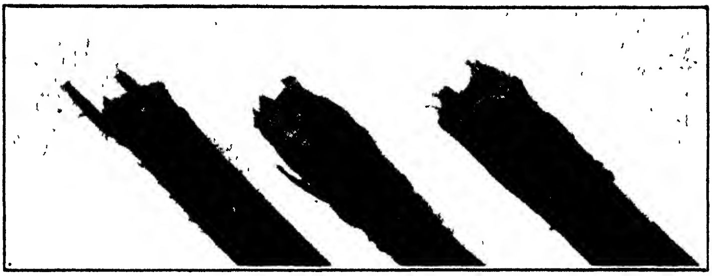


Fig. 1—Cane injury caused by new pest.

rugosa growing in the vicinity of the planting in 1931. During the latter part of July, 1932, canes of the plants under observation began to break over. Examination showed that 35 to 50 per cent of the canes were broken off at various distances from the ground. The reason for the breakage was the spiral burrowing of *Agrilus* larvae deep in the woody supporting tissue of the plant.

Closer inspection showed that the larvae causing the damage hatch from tiny eggs laid on the surface of the bark. The eggs resemble an oval scale insect about 1/25 on an inch in its shortest diameter. Examination revealed that from beneath each of them a tunnel extends into the bark and continues to spiral about the cane, destroying the cambium layer and with it taking a considerable portion of the woody supporting tissue of the cane. It is this injury that causes the breakage of the canes. The plant's reaction to this injury is the formation of a gall somewhat like the gouty gall caused by the red-necked cane-borer but different from it in that it may be found any place on the cane, whereas the gall of the red-necked cane-borer is more likely to be found in the vicinity of a leaf-axil, since the red-necked cane-borer seems to insert most of its eggs into the base of leaf petioles. Sections of stems infested with this new pest disclose that the larvae are, when found, in the gall or above it.

With this injury in mind, a close watch has been kept during the summer of 1932 for specimens of raspberry canes sent in to the Department from other parts of the state for identification as to cause of injury. A goodly percentage of such canes submitted have shown the work of the same borer. This is especially true of canes coming from eastern and southeastern parts of the state.

Fig. 2.—Eggs of new pest on raspberry canes, enlarged.

As to suggestions for control of this insect, it would appear from the meager observations upon its feeding habits and from what we know of its near relatives that a spray of arsenate of lead in late May or early June would reduce the infestation markedly. Cutting out the galled canes at the same time that canes injured by red-necked cane-borer, raspberry cane-borer, tree cricket, and cane maggot are removed will kill enough over-wintering larvae to afford a good percentage of control, if such prunings are burned immediately. These beetles have been bred from material collected from rose bushes and dried very completely. The practice of cutting off the "handle" or "stem" when setting raspberry plants will help prevent infestation and is at the same time insurance against other troubles. Until we know more about this pest, it would seem that planting of *Rosa rugosa* in the neighborhood of raspberries is likely to result in the infestation of the raspberries.

THE POTATO TUBER MOTH

R. H. PETTIT, SECTION OF ENTOMOLOGY

During late August, specimens of the potato tuber moth *Phthorimaea operculella* were sent in for determination. This lot of specimens consisted of a few potatoes badly infested by the potato tuber moth, which had been found at Owosso in the hands of a dealer. They were found to have come through Flint and to have been shipped from Virginia through Detroit. The serious nature of this finding was at once apparent and the matter was reported to Commissioner Powell, of the State Department of Agriculture, who immediately took measures to prevent the spread of the insect. During the investigation, it was found that thousands of barrels of potatoes had been shipped into Michigan from Virginia and that some of them had already been distributed over the State. Needless to say the large stock of potatoes in Detroit was seized and a vigorous campaign started to recover such as had already been distributed.

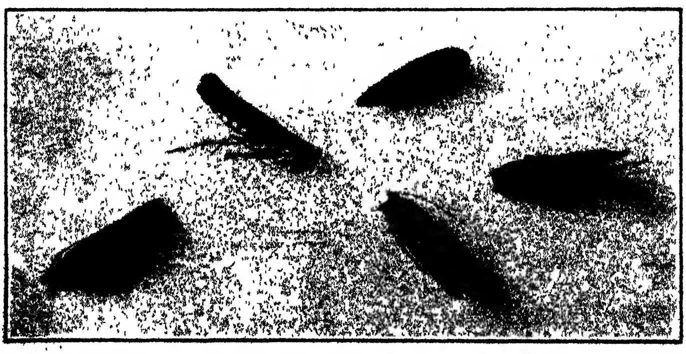


Fig. 1.—Adult moths of potato tuber-moth, slightly enlarged.

The potato tuber moth is a small gray moth, about half an inch or a little less in length, and which is known also as the tobacco split-worm, because of its habit of splitting the leaves and stems of tobacco where it tunnels under the skin. It attacks not only tobacco and potato, but also other members of the potato family. It works in the field after the manner just mentioned where it causes severe losses to tobacco and to potatoes in the south. It also works in potatoes in storage. Dry, hot weather is favorable to this insect, the climates of Florida, Texas, and California being especially favorable to this pest. It has also been established and has done considerable damage to potato in Maryland and Virginia, and to tobacco in the Carolinas.

The eggs, which are laid in storage potatoes about the eyes, hatch in from three days during warm weather to 15 days during cooler periods, the hatching being sometimes delayed as long as 52 days when the temperature falls below 52° F.*

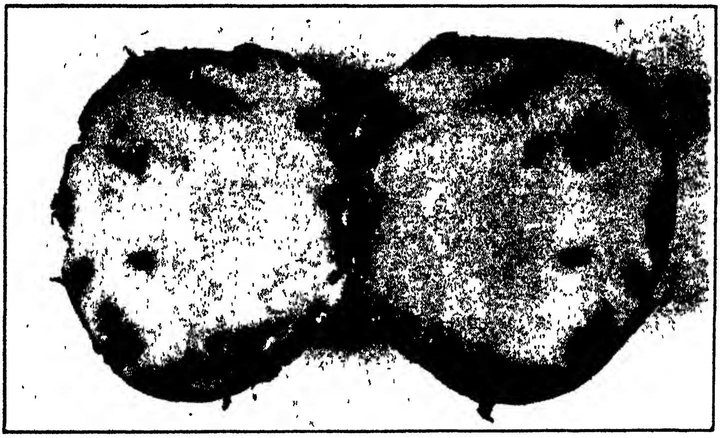


Fig. 2.—Potato showing work of potato tuber-moth larvae, slightly reduced.

The injury to the potato is caused by the tunneling of the larvae in the tubers and to the galleries cut in the leaves and stems.**

The injury to the tops is comparatively slight when compared with that incident to the work of the larvae in the tuber, which tunnels through the potatoes and ruins them for table purposes. The larvae gain entrance from the tops, making their ways into such tubers as are poorly covered or which lie very close to the surface of the soil. This attack is usually followed by the rotting of the tuber.

In California, there are five generations each year, the number of generations would naturally be reduced somewhat in Michigan, for no development takes place below 50° F. and the growing season is shorter in Michigan than in California. Although the creature may live in all stages at considerably lower temperatures in storage, it must be remembered that potatoes are

*Journal of Economic Entomology, Vol. 25, No. 3, June, 1932. George S. Langford and Dennis F. Cory.

**Bulletin No. 427, Bureau of Entomology, Professional Papers, February 6, 1917, by J. E. Graf.

stored at a temperature above freezing and that therefore, the potato tuber moth is protected from the effects of cold weather during the storage period.

Dr. J. E. Graf, recommends among others, the following methods of control which would be suited to Michigan conditions:

1. Plant as deeply as possible, at least five or six inches beneath the surface.
2. Use deep cultivation, keeping the potatoes covered in the row.
3. Harvest as early as possible.
4. Harvest before the potato tops become so dry as to induce the partly grown larvae to descend and work on the tubers.
5. Sacks should never be covered with potato tops, as the larvae leave the leaves when they wilt and enter, the potatoes.
6. The sacks should be sewed as soon as possible and hauled from the field. Potatoes should never be left in the field and exposed to the moth over night.
7. All culled potatoes should be gathered up within two weeks and either fed to livestock at once or destroyed.

Professor Graf recommends fumigation of affected potatoes with Carbon Disulphide, using two pounds to 1,000 cu. ft. of air space and allowing the fumigation to last 48 hours. Undoubtedly, propylene dichloride could be substituted for carbon disulphide, used at the rate of three pounds to a 1,000 cu. ft. of air space. Professor Graf also recommends that fumigation be repeated in a week in summer or in two weeks in winter; he also recommends a third fumigation, providing the tuber moth is still working. Finally, clean or uninfested potatoes should be kept away from the moth. Potatoes should never be left in the ground after they are ripened when the soil is dry. As a temporary measure, the affected potatoes may be kept in cold storage at a temperature of 37° to 40° F. It is not expected that the potato tuber moth will become as serious a problem in Michigan as in the states where the weather conditions are much dryer and where the temperature ranges higher; however, it is a very serious pest of potatoes and to a lesser degree of bittersweet, egg-plant, tomato, red pepper, tobacco, henbane, and matrimony vine. Night shade and several other plants of lesser importance have been attacked in southern California.

MUSHROOM MAGGOTS

E. I. MCDANIEL, ENTOMOLOGY SECTION

The increased interest in the culture of mushrooms during the last few years has led to repeated requests for information concerning insects and their allies destructive to mushrooms.

Mushrooms are grown in damp, dark cellars or in houses especially constructed for the purpose. To date, the best growing medium known is fresh horse-manure, properly composted. Unfortunately, there are many insects and allies of insects common to every locality that find such condi-

tions just suited to their development. Of these, perhaps the most destructive are the mushroom maggots. Several species* of flies of similar habits and life-history are grouped together as mushroom maggots.

Mushroom maggots often appear in mushroom houses during late summer and early fall. The adult flies are so small and inconspicuous that the beds usually become seriously infested before any suspicion of their presence is entertained. They breed in compost or in refuse from previous crops dumped near the buildings. Such flies are objectionable because they cause maggoty mushrooms and because they act as casual carriers of several mites and diseases destructive to mushrooms.

The flies develop rapidly; each female lays about a thousand eggs in the course of a life-time. During warm weather, three weeks is sufficient time to produce a complete life-cycle. Only three or four days are required for the eggs to hatch into tiny white maggots which, when full-grown, measure about one-fourth of an inch in length. The maggot is the feeding stage and requires from seven to ten days to complete its development. When mature, it enters the ground and forms a pupal or resting stage from which, in from seven to 10 days, the adult fly emerges.

During warm weather, the temperature in a house or cellar usually rises to 70° F. or above, and frequently the relative humidity drops below that point favorable for the development of mushrooms. Mushrooms seem to develop best where the relative humidity ranges between 75 and 85 per cent. Such conditions are ideal for the rapid development of insects, and it is possible under such conditions for flies to develop to such an extent that the entire crop will be ruined in a short time.

The fly places her eggs in the stem at the ground level or where the cap fits over the stem. The larvae tunnel in the mushroom, frequently riddling the entire center, but leaving the outside uninjured. Mushrooms so injured collapse when picked. Where small mushrooms are attacked they cease to grow and the development of a crop comes to a standstill. Where a house becomes infested after the spawn has been planted and before the mushrooms appear, the maggots may feed in the spawn, cutting it into short lengths and in places destroying the bed.

Part of the loss can be prevented by ordinary sanitary measures and by taking precautions against infestation. These may be enumerated as follows:

Dispose of all crop and spent manure remnants, either by fire or by spreading them out on a field at some distance from the house, the farther away the better. Soil from such fields should not be used for casing for three years, at least.

Fumigate the *empty* house early in the spring and again before putting in manure for the following crop. Make the building as tight as possible and burn five or six pounds of sulphur per 1,000 cubic feet. Fumigations are more effective in warm weather and when the air is still. Night fumigations seem more effective than daylight fumigation. *Never fumigate a house with sulphur when mushrooms are growing.*

Screen all windows, doors, and ventilators with fine wire (30-mesh) or use cloth.

The compost heats up immediately after being placed in the beds. It is not advisable to allow the temperature to rise much above 150° F., though it

*Sciarids, or fungus gnats; and Phorids, or manure flies.

is a wise precaution to fumigate when the temperature of the beds is about 150° F. with sulphur, using two pounds to 1,000 cubic feet of air space. At such times, insect and other pests are driven out by the heat from the center of the manure to the surface and are where the fumigant is effective. There are other fumigants which may be used at this time, but, where the house is isolated and sulphur fumes will do no harm, it is desirable because sulphur serves not only as an insecticide but to a certain extent as a fungicide as well. *Never use sulphur after the spawn has been planted.*

Where insects appear after the spawn has been planted or after the mushrooms have appeared, either a nicotine fumigation or a pyrethrum dust should be used. Where nicotine is to be used, secure a powder with a high nicotine content, and repeat the fumigation at short intervals. It will be necessary to raise the temperature of the house to 65° or 70° F. for several hours before and during the fumigation. High temperatures are also essential where pyrethrum dusts are used. Three or four ounces of dust are required for each 1,000 cubic feet. No spray or dust containing either soap or oil should be used in a mushroom house.

Experimentally, a Sciarid infestation has been successfully eliminated from a bed of mushrooms growing in a basement under a dwelling by the use of one of the acetone extracts of pyrethrum. The maggots were thick in the spawn and in the "bubbles." The pyrethrum preparation was diluted 1 to 400 and on alternate days applied lightly to the bed with an atomizer, after which a cheese-cloth blanket was fastened over the top of the bed. After four applications, the adult flies disappeared and no maggots were observed in the mushrooms or in the soil. The additional moisture raised the relative humidity, and the rapidity of the growth of the mushrooms was decidedly increased.

Mushroom maggots are not a problem where the temperature of a house can be held at 55° F.

925 FARM ACCOUNT RECORDS FOR 1931*

Some of the Reasons for the Differences in Farm Earnings Between 290 More Profitable and 290 Less Profitable Michigan Farms

A. M. HAUKE, SECTION OF FARM MANAGEMENT

The records on 925 farms in Michigan in 1931 showed there were wide variations in farm earnings on neighboring farms even under similar economic and physical conditions. The extreme range in the operator's labor and management wage between farms for 1931 was from a plus $2,557 to a minus $6,788. The operator's labor and management wage for the 290 more profitable farms averaged $50 and for the 290 less profit-

*The figures in this article are from the data assembled in the Extension Project in Farm Accounts by H. A. Berg, A. M. Hauke, K. T. Wright, and P. F. Aylesworth, of the Farm Management Department.

able farms it was $-1,444. The rate earned on the investment for the two groups was .94 per cent and -4.89 per cent, respectively.

The wide differences in farm earnings may be accounted for largely by (1) a larger volume of business, (2) a lower overhead, (3) more livestock per tillable acre, (4) higher returns per head of livestock, (5) a higher percentage of the tillable acres in legumes, and (6) greater labor efficiency per man. The more successful farms excelled in these factors.

The operator's labor and management wage for these 925 farms for 1931 was $-676. This was a drop of $413 from what it was in 1930 and of $1,220 from the 1929 figure. The operator's labor and management wage is considered the best measure of financial success for Michigan farms. It is the amount of money left after deducting from the farm receipts all the cash expenses for operating the farm, any decreases in inventory, a charge for the cash cost of board furnished the hired help, a charge for the unpaid family labor, and five per cent interest on the total investment.

The rate earned on the investment is another measure of farm earnings. It was -2.7 per cent for the 925 farms in 1931. In 1930, the 771 farms averaged -.4 per cent and it was 4.5 per cent for 486 farms in 1929. Several causes were responsible for these low earnings, but in the main they were due to the low prices received for crops, livestock, and livestock products sold, and to the inventory losses on account of the drop in prices during the year. Table 1 shows the various earning figures for all the farms and for the high group and low group of farms.

Table 1.—A statement which shows the financial earnings for all 925 farms and for the most profitable and least profitable group of farms, Michigan, 1931.

	Average 925 farms	Average 290 high farms	Average 290 low farms
Cash receipts per farm, total	$2,299	$2,261	$2,380
Cash expenses per farm, total	1,487	1,270	1,673
Excess of receipts over expenses	812	991	707
Less: Decrease in inventory	520	188	912
Return for capital, management and family labor	292	803	−206
Less: 5 per cent interest on the investment	793	613	1,003
Return for family labor and management	−501	190	−1,209
Less: Unpaid family labor other than operator	175	140	235
Operator's labor and management wage	−676	50	−1,444

The total cash receipts averaged about the same for both the high and low groups, $2,261 and $2,380, respectively. This was all of the money taken in from the farm during the twelve months of the record. Unless supplemented by other sources of income, this was the amount of money available during the year for the payment of all expenses incidental to operating the farm, for interest and principal payments on any obligations, for improvements or investment, and for all household and personal expenses. The total cash expenditures for farm purposes averaged $1,270 for the high group and $1,673 for the low group. The difference between the cash receipts and cash expenses left $991 and $707 for the two groups, respectively. This was the amount of money left for all other purposes.

Table 1 also shows the more profitable farms had a smaller decrease in value of the inventories and a smaller interest charge. The decrease in inventory in 1931 was due largely to falling prices of livestock, and of feed,

crops, and supplies. No change in real estate values was made other than the normal depreciation on the farm improvements. In general the smaller farms had the highest operator's labor and management wage for 1931. During periods of steady or rising prices, the larger farms offer the opportunity of making greater net incomes. However, during periods of falling prices, or when climatic conditions are adverse, the larger farms usually incur the greatest losses.

The particular factors affecting the financial returns of the farm business are often not clearly recognized, but, in general, they may be divided into two classes: (1) The factors not under the control of the farmer, such as weather, price fluctuations, and accidents; (2) the factors which are largely or entirely within the control of the farmer, such as (a) the farm organization or the form which the farm business takes in respect to size, production factors used, lines of production carried on, and general policy adopted, (b) the operation or the running of the business as a going concern and (c) buying and selling.

This article will deal largely with the factors of farm organization which affect farm earnings and which are largely within the control of the farmer. These factors include the following: (a) the size and volume of business, (b) crops, (c) livestock, and (d) labor efficiency. Average figures for all 925 farms will be given and a comparison made of the 290 more profitable and the 290 less profitable farms. An effort will be made to show what factors were responsible for the higher earnings of the more profitable farms.

The Relation of Size and Volume of Business to Farm Earnings

As the volume of business increases on farms of similar size, the profit tends to increase, for every farm has certain overhead expenses that remain practically the same regardless of the amount of sales. For example, every farm has to carry the expenses of land, labor, and upkeep and depreciation of buildings and machinery. These burdens fall heavily on both small and large farms doing a small volume of business.

The more important measures of the size and volume of business are (1) total number of productive man work units, (2) total receipts and net increases, (3) total expenses and net decreases, (4) total capital investment, (5) total number of productive animal units, (6) the number of men, (7) number of tillable acres, and (8) the number of acres in the farm. The relation of these factors to farm earnings are shown in Table 2.

Table 2.—Data which show various measures of the size and volume of business and their relation to farm earnings, Michigan, 1931.

	Average 925 farms	Average 290 high farms	Average 290 low farms
Operator's labor and management wage	$ −676	$50	$ −1,444
Productive man work units, total	413	386	462
Receipts and net increases, total	$1,414	$1,728	$1,379
Expenses and net decreases, total	1,122	925	1,585
Capital investment, total	15,859	12,254	20,063
Productive animal units, total	22	19	27
Number of men	1.8	1.6	2.0
Number of tillable acres	109	90	132
Acres in farm, total	168	136	203

The total productive man work units averaged 386 for the high group and 462 for the low group. This difference was largely due to the fact that the farms in the latter group were larger and they had larger acreages of crops. The productive man work units measure the total amount of productive work each farm provided.

The more profitable farms had receipts and net increases of $1,728. They averaged 136 acres in size and had an average investment of $12,254. The less profitable farms had receipts and net increases of $1,379; these were farms that averaged 203 acres in size with an average investment of $20,063. This shows the high farms did about the same volume of business on a smaller number of acres and with less expense than the low farms.

In order to compare the amount of livestock kept, all productive stock was converted to a common unit called a productive animal unit. On this basis, the high farms averaged 19 productive animal units and the low farms 27. However, the high farms had more livestock per acre than the low farms since the acreage in this group was smaller.

The Relation of the Crops Program to Farm Earnings

The crop and soil programs are fundamental to the welfare of the entire farm organization. The more successful farms usually have a higher per cent of the tillable acres in legumes and obtain higher crop yields than are usually found on less successful farms.

Table 3.—A comparison of the per cent of the tillable acres in legumes and crop yields per acre with farm earnings, Michigan, 1931.

	Average 925 farms	Average 290 high farms	Average 290 low farms
Operator's labor and management wage	$ −676	$50	$ −1,444
Acres per farm, total	163	136	203
Tillable acres per farm, total	109	90	132
Per cent of tillable acres in legumes	23	25	22
Crop yields per acre (bushels)			
Corn for grain	32	28	30
Oats	36	35	32
Barley	30	29	28
Wheat	29	29	27
Beans	10	10	9
Potatoes	139	150	149

Table 3 shows the high group averaged a little higher yields in all crops except corn. However, the differences were so slight that very little of the differences in income could be attributed to that factor. There was one difference of considerable importance and that is the difference in the per cent of the tillable acres in legumes, which averaged 25 per cent for the high group and 22 per cent for the low group.

The Relation of the Livestock Program to Farm Earnings

Eighty-seven per cent, or $1,224, of the total receipts and net increases per farm came from livestock and livestock products. The income from dairy products accounted for 65 per cent of this amount. The relation of the amount and efficiency of livestock to farm earnings is shown in Table 4.

Table 4.—Data which show the relation of the amount and efficiency of livestock to farm earnings, Michigan, 1931.

	Average 925 farms	Average 276 high farms	Average 276 low farms*
Operator's labor and management wage	$-676	$50	$-1,444
Productive man work units on productive livestock	219	219	240
Number tillable acres per animal unit	5.0	4.7	5.1
Investment in productive livestock per tillable acre	$13 57	$14 40	$13.84
Receipts from productive livestock per tillable acre	11.24	15 75	8.41
Returns per $100 invested in productive livestock	83	109	61
Number of cows	9.1	8 6	9.5
Dairy products sold per cow	$88	$99	$76
Number of hens	94	96	74
Value of eggs sold per hen	$1 92	$2 15	$1.68

*The livestock factors of Area 12 A South and 12B, the fruit regions of the State, were omitted.

The balance between crops and livestock is indicated by the number of tillable acres per productive animal unit. The higher profit group had an average of 4.7 acres per productive animal unit compared with 5.1 acres for the lower income group, which means the more profitable farms had more livestock per acre. The balance is also indicated by the relative amounts of productive man work units on livestock and on crops. The farmers in the more profitable group spent less of their time on crops and more of their time on livestock than did those in the less profitable group.

The investment in productive livestock per tillable acre was about $14 for each group, yet the high farms received nearly $16 per tillable acre from this source compared to a return of $8 per tillable acre for the low farms. The farmers of the high group either were better managers and feeders, had better quality livestock, sold at higher prices, or perhaps combined all three, because for every $100 invested in productive livestock they received $109 compared to $76 for the low group.

The quality of livestock and kind of production practices followed on the high profit farms is shown by the production per animal. The value of the dairy products sold per cow averaged $99 for the high group and $76 for the low group. The value of the eggs sold averaged $2.15 per hen on the high farms and only $1.68 on the low farms.

The Relation of Labor Efficiency to Farm Earnings

One of the farmers' most difficult jobs is to determine the kind, amount, and intensity of crops and livestock that will give the greatest returns for the labor expended. A farmer should develop a combination of crops and different types of livestock on his farm so that his own time and that of his help are employed on productive work throughout the year. Generally, the larger amount of work provided by the farm the more efficient will the labor be utilized. Table 5 brings out some of these differences for 1931.

The figures in Table 5 show the low farms provided 203 productive man work units on crops and 240 on livestock compared to 145 by crops and 219 by livestock for the high group. The average number of men was about the same, yet each man in the high group accomplished 238 productive man work units compared to 230 per man for the low group. The high group secured an income of $1,067 per man against $686 per man for the

Table 5.—Comparison of labor efficiency and farm earnings of all farms and the high and low groups, Michigan, 1931.

	Average 925 farms	Average 290 high farms	Average 290 low farms
Operator's labor and management wage	\$ −676	\$50	\$ −1,444
Tillable acres per farm	109	90	132
Number of men	1 8	1 6	2.0
Productive man work units, total	413	386	462
Productive man work units, on crops	176	145	203
Productive man work units, on productive livestock	219	219	240
Productive man work units, per man	235	238	230
Receipts and net increases per man	\$804	\$1,067	\$686

low group. When the productive man work units were compared on a tillable acre basis some interesting results were obtained.

The high group averaged 4.3 productive man work units per tillable acre compared to 3.5 per tillable acre for the low group. This is a measure of the intensity of the farm business and it shows the high group was 23 per cent more intensive than the low group. However, the high group actually did a business 56 per cent larger per man than did the least profitable group as shown by the receipts and net increases per man of \$1,067 and \$686 for the two groups, respectively. This leaves 33 per cent due to more efficient management, higher production per acre, to the kind of livestock and higher income per unit of livestock, and to changes in the inventory in favor of the most profitable group.

Table 6.—Data which show the productive man work units per tillable acre for the high farms and the low farms and the per cent the high group was over the low group, Michigan, 1931.

	Average 290 high farms	Average 290 low farms	Per cent high group was over low group
Tillable acres per farm	90	132	
Receipts and net increases per man	\$1,067	\$686	56
Productive man work units per tillable acre	4.3	3.5	23
Productive man work units on crops per tillable acre	1 6	1.5	7
Productive man work units on productive livestock per tillable acre	2 4	1 8	33

The high group also had 7 per cent more productive man work units on crops per tillable acre, since they had proportionately more cultivated crops than the least profitable group. They also had 33 per cent more on productive livestock, due to more livestock per acre or the kind of livestock that required more labor. This would show the more profitable farm operators were better managers, had proportionately more cultivated crops, and had more livestock per acre or the kind that required more labor than the least profitable farms.

The problem of good farm management is one of selecting the best combination of crop and livestock enterprises and handling these enterprises efficiently to produce the largest average net income over a period of years. Generally, the more successful farmers exert every effort to obtain as large

a volume of business as possible on the farms which they operate. This large volume of business must, of course, be obtained at the lowest possible cost per unit. On many Michigan farms, the best method of increasing the volume of business is by adding more productive livestock, by increasing the crop and livestock production per unit, growing more intensive feed and cash crops, building up special markets for the farm products, and securing work off the farm if it does not interfere with the farm work.

The efficient farm operator will study the effect of changing conditions on his business and will plan his operations to work with the changing forces and not against them. This does not mean there must be a constant change in enterprises nor in operating methods. It does mean the adoption of a carefully thought out plan of operation definite enough to keep one from acting too short-sightedly but the plan should be flexible enough to permit making adjustments necessary to meet changes in price and climatic conditions.

WHAT CHANGES ARE FARMERS MAKING

The Financial Records of 87 Farmers in Central Michigan for the Three Year Period 1929 to 1931 Show How Farmers Are Meeting the Present Situation

P. F. AYLESWORTH, SECTION OF FARM MANAGEMENT*

During the three-year period 1929 to 1931 prices received by Michigan farmers for farm products** declined 40 per cent compared to a decline of only 18 per cent in prices of things farmers buy. The drop in prices of farm products presents a real problem to the individual farmer when he must keep cash receipts up to nearly the level of previous years. This study was made to determine the changes farmers are making to meet this situation. The records used were obtained from farmers enrolled in the Farm Accounting Project which is sponsored by the Farm Management Department of Michigan State College. The object of the project is to study the factors of farm organization and operation, over which the farmer has control, for the purpose of increasing the financial returns from the farm business. The project is open to any farmer in a county receiving the service and enrollment is entirely voluntary with no attempt to select certain farms.

The year 1931 was the third year of this project and 1,012 cooperators submitted completed records to be summarized. This record consists of a complete farm inventory taken at the beginning and again at the end of the

*The data for this analysis were obtained from the Farm Accounting Project records. The following members of this department helped to start, collect, and summarize the data; E. B. Hill, Head of Department, H. A. Berg, Extension Specialist, A. M. Hauke, Extension Specialist, K. T. Wright, Research Assistant and P. F. Aylesworth, Research Assistant.

**Prices index of Michigan farm products obtained from unpublished data of Professor O. Ulrey of the Economics Department, Michigan State College.

accounting year, a complete record of all farm income and expenses, and some production records.

The records of the same 87 farms in south central Michigan which were complete for the three years were used to make this study. This is the general farming region and one of the largest areas in the State in which a similar type of farming predominates. The major cash crops are wheat, beans, and sugar beets. The important livestock enterprise is the dairy which is supplemented by hogs, sheep, and poultry.

The records from the 87 farms were averaged for each of the three years. Changes in organization, management, and earnings from the farm are shown by these comparisons. The first step in the analysis was to make a summary of cash receipts with the share the various enterprises contribute and cash expenses showing where the money goes. This comparison is given in Table 1.

Table 1—Comparison of cash receipts and cash expenses on 87 farms for the three-year period, 1929-1931.

Items	1929	1930	1931	Per cent change 1929 to 1931
Cash Receipts	$4,358	$3,525	$2,410	−44.7
Livestock sales	3,096	2,358	1,705	−44.8
Dairy sales	1,408	1,184	869	−38.3
Egg sales	212	185	153	−27 8
Cattle sales	682	504	329	−51 7
Hog sales	379	232	165	−56.5
Sheep sales	251	179	81	−67.8
Poultry sales	125	90	76	−39.2
Miscellaneous	38	34	32	−15 8
Crop sales	1,018	961	553	−45 7
Labor off farm	87	83	71	−18 4
Miscellaneous receipts	157	123	81	−47.8
Cash Expenses	2,843	2,304	1,505	−47.1
Livestock purchases	406	275	175	−56.9
Feed expense	450	362	175	−61.6
Farm improvements	340	263	158	−53 5
Machinery and equipment	676	485	282	−58.3
Livestock expense	51	40	35	−31.4
Crop expense	298	286	205	−31 2
Hired labor	307	291	212	−30 9
Taxes	295	285	250	−15 2
Miscellaneous expense	20	17	13	−35 0
Cash Income (Receipts less Expenses)	1,515	1,221	905	−40 2

The total cash receipts averaged $2,410 a farm for the 87 farms in 1931. This is a drop of approximately 45 per cent since 1929. This is all the money taken in from the farm during the twelve months of the record. Unless supplemented by other sources of income, this is the amount of money that could be used during the year for the payment of all expenses incidental to operating the farm, for interest and principal payments on any obligations, for improvements or investments, and for all household and personal expenses.

Livestock sales make up 70 per cent and crop sales 23 per cent of these cash receipts. Crop sales dropped just 1 per cent more than livestock sales. There was some shift in the livestock enterprises making up these sales. The poultry and dairy enterprises held up the best while meat animals dropped nearly a half lower. Loss in sheep sales was greatest with a 67.8 per cent drop.

Cash expenses, which dropped 47 per cent, have been cut even more than cash receipts. The big reductions have been in livestock purchases, feed expense, improvement cost, and machinery expense. There seems to be a tendency not to cut the items that reduce production. The 31 per cent reduction in hired labor is the result of a cut in wage rate and not in amount of labor hired. Part of the 31 per cent decrease in crop and livestock expense is a result of lower rates for things purchased rather than the reduction in good practices followed such as applying fertilizer, spraying, and using good seed.

The difference between the cash receipts and cash expenses is the cash income from the farm. This item shows a reduction of 40 per cent from 1929 to 1931. Most people have no more record of their business than this simple cash record. This information in itself is not sufficient. A complete farm inventory and record of other than cash expenses as well as the cash record is essential in order to measure financial returns. These other charges and earnings from the farms are given in Table 2.

Table 2—Data from the three-year's records showing inventory changes, other than cash expenses and earnings.

Items	1929	1930	1931	Changes 1929 to 1931
Inventory change during the year	$239	$ -595	$ -928	$ -1,167
Livestock	-14	-378	-389	-375
Crops	60	-181	-306	-366
Farm improvements	90	0	-91	-181
Machinery and equipment	103	-36	-142	-245
Unpaid family labor	266	229	191	-75
Net farm income	1,488	397	-215	-1,703
Interest on investment at 5 per cent	1,077	1,072	1,058	-19
Operator's labor and management wage	411	-675	-1,272	-1,683
Operator's labor charge	698	698	575	-123
Rate earned (per cent)	3.66	-1.41	-3.73	-7.38

The continuous decline in the price level made it necessary to write-off the inventory in certain items in excess of normal depreciation which must be recognized every year. The drop in value was taken on all marketable items and normal depreciation was taken on buildings, fence, machinery, and equipment but the shrink in real estate values was not shown. Very few farms showed an increase in inventory for either 1930 or 1931. Although possibly more units of the various products were on hand, the decreased price per unit caused a decrease in total inventory.

The average decrease in inventory from 1929 to 1931 was $1,167. Of this amount, 32 per cent was in livestock, 31 per cent in crops, 21 per cent was in machinery and equipment, and 16 per cent was in farm improvements. This loss in inventory and a charge for unpaid family labor have been taken from the cash income to give the net farm income. This shows a net farm income $1,703 less than 1929.

This net farm income represents the returns for the capital invested and for the operator's own labor. Subtracting interest at 5 per cent on the total capital investment gives the operator's labor and management wage or by subtracting the operator's labor the rate earned on investment is shown.

This shows a drop of 7.38 per cent on investment from 1929 to 1931.

It is apparent from Table 1 that farmers are putting forth every effort to cut expenses. They have succeeded in cutting cash expenses in line with the lowered cash receipts. The net farm income as shown by Table 2 is greatly reduced, however. This is due to expenses over which a farmer has little or no control. These major expense items known as fixed or overhead costs did not decrease in proportion to the income in 1931. Expenses for interest, taxes, machinery, and farm improvements have shown comparatively small decreases or actual increases. These expenses are shown in the following table.

Table 3—Data showing change in overhead costs on the 87 farms from 1929 to 1931.

Items	1929	1930	1931	Per cent Change 1929 to 1931
Overhead or fixed costs	$3,039	$2,981	$2,690	−11 4
Operator's and family labor	964	927	766	−20 6
Interest	1,077	1,072	1,058	− 1.8
Taxes	295	285	250	−15 2
Farm improvement net decrease	231	240	241	4 3
Machinery and equipment net decrease	472	457	375	−20 5
Other expenses	1,532	1,271	815	−47 0
Total expense	4,571	4,252	3,505	−23 3

The overhead costs show a drop of only 11.4 per cent from 1929 to 1931. With cash receipts cut 45 per cent it means that all of these costs will not be met. The result is that the physical plant will become run down, buildings will not be painted, and fence and machinery will not be replaced. Interest payments will be defaulted and taxes delinquent in some cases.

Reducing farm expenses is one of the two ways of increasing net farm income. If everything has been done along this line that can be there is still another method. That is to increase the volume of business with the present overhead and expense. A measure of the numbers of livestock,

Table 4.—Increase in volume of business on the 87 farms as measured by livestock numbers, crop acres and number of men per farm.

Items	1929	1930	1931	Per cent change 1929 to 1931
Number of				
Dairy cows	9 48	9.63	9 78	3 2
Sows	1 38	.90	1 14	−17 4
Ewes	16 4	18 5	19 2	17.2
Hens	93 3	89 0	94.7	1.4
Pigs raised	14 8	10.9	14 4	−2.5
Lambs raised	13 6	16 3	19.2	40.6
Total acres in farm	169 0	169.5	175 4	3 8
Tillable acres	117 4	117 6	123.0	4 8
Crop acres	98 5	102.4	106 4	8.1
Number of men	1 79	1 84	1 86	3 9
Crop acres per man	55.1	55.4	57.3	4.0
Cash receipts per tillable acre	$37.12	$29.98	$19.60	−47.2
Cash expenses per tillable acre	24.12	19.79	12.24	−49.4

number of crop acres, and number of men on the farms studied shows changes in volume and intensity of business. These changes are shown in Table 4.

The farmers in this area are attempting to balance the big drop in prices which has so greatly lowered cash receipts by increasing their volume of business and efficiency of production as well as by cutting cash expenses. There has been an increase of 8 per cent of crop acres farmed and an increase of 4 per cent in the number of men per farm. Some farmers are securing additional income from outside work to use their labor and equipment to greater advantage.

The volume of business can usually be increased greatest through increase in number of livestock. There is an increase of 17.2 per cent in the number of ewes and also an increase of 20.6 per cent in the number of lambs raised per ewe. The increase in numbers of dairy cattle and hens and the decrease in numbers of sows indicates a shift to more intensive type of livestock. The number of sows on these farms in 1931 is 17.4 per cent less than in 1929 but due to raising more pigs per sow the number of pigs per farm was about the same in both years.

The men enrolled in the Farm Accounting Project, from which these records were taken, recognize the help a farm budget and farm account can be to them in planning their farming operations. In attempting to meet these changed conditions, they find real aid in such lessons of the farm accounts as greater efficiency in livestock and crop production, labor efficiency, and lower machinery costs.

With prices such a large factor in gross income, the individual farmer can do little more to increase it except through better marketing methods or some change in production to produce the choice and higher quality products. In general, these farmers are continuing their regular lines of production. They have worked out long-time programs to meet their special physical and marketing conditions.

At this time of the year, many of the most thoughtful farmers of the State are studying their farming program with reference to the factors that affect farm earnings. The farming business, more than many others, requires careful planning ahead. The term "farm budgeting" has been applied to this systematic planning for the future operations of the farm business. This should include an estimate of how much money must be spent for cash farm expenses, allowance for depreciation of working capital, payments on notes, personal and household expenses, and the amount and source of money taken in. The farm budget also provides a plan for estimating the relative profitableness of different combinations of crops, or crop and livestock enterprises for the coming year.

This year, more than ever, the farmer is confronted with the problem of making choices as to the kind of crops and number of acres he will grow and the kinds and amounts of livestock he will keep. In doing this, he is attempting to adjust his program to meet the market demand for the products which he will produce. Though it is difficult to forecast prices and crop yields and livestock production exactly, estimates can be made close enough to determine which type of organization is the most satisfactory.

The United States Department of Agriculture and Michigan State College issue the Michigan Agricultural Outlook each year with the purpose of providing information relative to supply and demand conditions under which farm products may be marketed during the coming year. This material

should prove helpful in supplementing the information from the Farm Account* to prepare the farm budget for 1933.

FEED AND LIVESTOCK PRODUCT PRICE RATIOS

A Study of the Relation of the Price of Feed to the Price of Dairy and Poultry Products in Michigan, 1921-1932

P. F. AYLESWORTH AND E. B. HILL, SECTION OF FARM MANAGEMENT

Livestock occupies an important position in the agriculture of Michigan. The major livestock enterprise is dairying, on account of close proximity to large cities. Poultry, hogs, and sheep are handled as minor enterprises on most farms.

Evidence that the livestock enterprise is a desirable one for Michigan farmers is shown by the price relationship which exist between feed crops and livestock products. The index numbers of Michigan farm prices, which show the percentage which present prices are of the 1910 to 1914 base, gives a good basis for comparison of the relative profitableness of the livestock enterprise. From 1921 to 1931 inclusive, feed crops in Michigan averaged 95 per cent of the base period, dairy products averaged 167 per cent, poultry products 150 per cent, meat animals 135 per cent, and the average of all products 146 per cent. On the same basis, for the first seven months of 1932, feed crops averaged 53 per cent, dairy products 87 per cent, poultry products 75 per cent, meat animals 69 per cent, and the average of all products 69 per cent. Although the general price level of agricultural products has dropped over 50 per cent, the feed crops have dropped approximately the same rate as the livestock products. Thus the relation between feed and livestock prices indicates a favorable feeding ratio for 1932.

Feed, labor, and overhead are the main items of cost that enter into the production of livestock and livestock products. The proportion of feed of the total cost of production varies according to the class of livestock, from about 75 per cent of the cost of producing pork, 55 to 60 per cent of the cost of producing milk, to approximately 50 per cent of the cost of producing eggs. The corn-hog ratio (number of bushels of corn 100 pounds of pork will buy) has frequently been used to illustrate feed-livestock ratios and is a good indicator of profitableness in the hog enterprise. For example, the year 1926 is considered the most profitable year for feeding hogs in the last 10. One hundred pounds of pork would buy 16.7 bushels of corn that year, while the average for the ten-year period is 11.3 bushels of corn.

Michigan farmers raise the greater part of the feed that goes into the production of livestock and livestock products. It is important then to determine the most profitable market for this feed. The farmer wants to know what class of livestock has the most favorable feeding ratio and also

*More complete information and copies of the Farm Budget Outline and Farm Account Book may be secured by writing the Farm Management Department, Michigan State College, East Lansing, Michigan.

the extent to which he should push the enterprise. The livestock enterprises, dairy and poultry, return the major share of the cash income to Michigan farmers and therefore represents the market for the greater part of the grain and roughage. A study of these feeding ratios should prove the benefit in solving this feeding problem.

The Dairy Feed-Butterfat Ratio for Michigan

The farm price of butterfat is used to represent the dairy industry in Michigan. The price of butterfat is used instead of the price of milk because of the difficulty of getting a representative price of milk and because a considerable portion of the State is still on a butter-fat basis. The amount and variety of the feeds used in the dairy ration are based on Michigan cow testing results. The records of over 4,000 cows were summarized to determine the feed requirements of producing 100 pounds of milk. This ration used in producing 100 pounds of milk or 3.5 pounds of butterfat is as follows: grain 31 pounds (oats 3 parts, corn 2 parts, barley 2 parts, cottonseed meal 1 part), hay 42 pounds (half mixed hay and half alfalfa hay), and silage 78 pounds.

The price of butterfat* divided by the price of the dairy ration** gives

Table 1.—Number of pounds of dairy ration equal in value to one pound of butterfat, by months 1921 to 1932 (corrected for seasonal variation).

	Jan.	Feb	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Av.
1921	68 0	65 9	71 6	77 8	55.3	53 8	65 9	76 8	67 6	70 9	75 1	71 4	68.6
1922	59 4	61 8	55 9	56 8	61 6	65 2	67 5	62 9	66 0	70 8	76 4	84 5	65.3
1923	78 6	78 1	77 4	77 5	74 2	70 1	69 6	70 6	73 5	71 0	73 0	70 5	74 4
1924	73.5	72 4	65 1	58 6	57 4	61 6	63.4	52 1	54 5	50 8	50 7	56 6	59 4
1925	53 7	54.6	61 4	64 0	70 8	70.6	65 0	60 7	64 9	70 3	67 4	65 5	64 6
1926	65 8	65 9	66.8	64 4	66 8	70 6	70 9	68.3	71.0	70 5	72.9	77 4	68 7
1927	74 5	77 8	81 4	81 5	77 6	74 1	71.0	68 8	69 6	72.9	70 8	72 2	75.0
1928	71 5	70 2	67 6	64.6	64 9	66 4	64 5	73.8	74 7	72 1	70 1	72 2	68.3
1929	71 1	71.7	72 4	70 5	78.2	78 2	73.8	72 7	68 9	68 5	63 7	60.2	71.2
1930	56 3	57 0	54 1	60 7	64.9	59.6	61 6	63 5	61 7	57 1	54 8	46.9	58.6
1931	44.0	42.2	46 0	47 7	43 5	45 9	51 4	59 2	65.4	75 0	66 1	64 3	53 3
1932	58.0	51.6	52.5	48 1	48 3	48.6	48.5	55 3	52 0	.....	.....	......	......

*Prices Michigan farmers received for butterfat by months. Reported by U. S. D. A. Bureau of Agricultural Economics in cooperation with the Michigan Department of Agriculture.

**Prices Michigan farmers received for corn, oats, barley and hay by months, reported by U. S. D. A. Bureau of Agricultural Economics in cooperation with the Michigan Department of Agriculture. Cottonseed meal reported by the Bureau from 1921 to 1925; from 1926 to 1932 the wholesale price at Chicago plus $8.00 per ton handling charge was used. Silage value was estimated on a yearly basis.

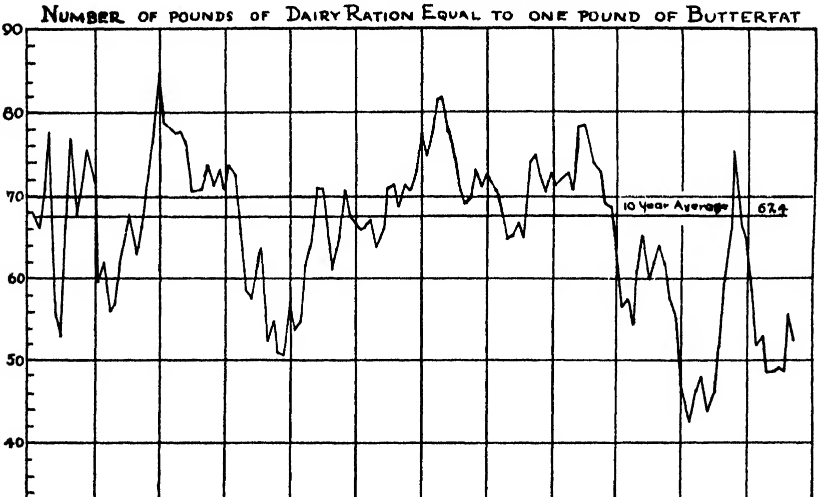
the feed ratio. This is expressed as the number of pounds of dairy ration a pound of butterfat will buy. The ratio is then corrected for seasonal variation to take out the regular fluctuations which occur during the year. Any change in the ratio, therefore, shows the result of changes in the price relationships of butterfat and dairy feed. This ratio from 1921 to date is shown in Table 1 and in Graph I.

The average number of pounds of this ration that a pound of butterfat would buy was 67.4 for the ten-year period, 1921 to 1930, inclusive. The amount of feed of the ration used in this report to produce a pound of butterfat was 43 pounds. This is 64 per cent of the amount of feed a pound of butterfat would buy during this period.

The general trend in the price of butterfat was upward until near the close of 1929. In 1931, the price of butterfat dropped to pre-war levels. Feed prices followed this drop but lagged so that the year 1930 and the first six months of 1931 showed the most unprofitable feeding ratio in the last eleven years. The year 1931 showed extreme fluctuations with a low point of 42.2 pounds in February and a high point of 75.0 pounds in October, Graph I.

DAIRY FEED – BUTTERFAT RATIO IN MICHIGAN

(Corrected for Seasonal Variation)



The drop in butterfat prices has continued in 1932 reaching a low point of 15 cents in June. The most unfavorable feeding ratio was in April with 48.1 pounds of feed equal in value to a pound of butterfat. There has been a slow advance in the ratio from this low point due to the fact that feed prices continued to drop even lower than the drop in price of butterfat. The price of butterfat showed signs of recovery in the month of August and the ratio reached 55.3 pounds. In September the ratio turned downward again due to the failure of butterfat prices to make the normal seasonal advance of 5.7 per cent from August to September.

The situation of the dairy enterprise at the present time shows that unless the decrease in consumers incomes is checked, the ratio between prices

of feed and prices of dairy products will probably be even less favorable for dairying in deficit feed areas than during the past two seasons. In surplus feed areas, however, the ratio will probably be more favorable.

The Poultry Feed-Egg Ratio for Michigan

The relation between the price of feed and eggs is used to illustrate the relative profitableness of marketing feed through the poultry industry. The poultry ration used is made up of corn 40 per cent, wheat 40 per cent, oats 10 per cent, and meat scrap 10 per cent. Prices for feed and eggs are obtained from the same source as the dairy prices. The ratio is also corrected for seasonal variation. The regular seasonal variation for the past 10 years has shown a rise of 63 per cent for September to December and a drop of 48 per cent from February to May. The seasonal effects such as these have been eliminated so that the actual changes in the relation of feed prices to egg prices may be shown. These ratios are shown in Table 2 and Graph II.

Table 2—Number of pounds of poultry ration equal in value to one dozen eggs, by months 1921 to 1932. (Corrected for seasonal variation.)

	Jan	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Av.
1921	21.1	12.8	18.5	17.0	16.8	16.9	20.7	22.4	20.7	22.4	22.8	23.4	21.2
1922	18.4	20.9	18.3	17.1	17.7	17.7	18.0	16.0	17.4	19.6	18.6	18.8	18.1
1923	17.5	17.5	20.3	16.4	16.9	16.2	16.1	16.4	16.9	17.3	18.6	18.8	17.2
1924	17.6	21.5	16.5	16.9	17.5	18.7	16.4	15.6	16.2	14.7	14.2	15.2	16.8
1925	16.2	15.1	13.7	15.9	16.1	16.6	16.3	15.4	14.3	15.4	15.9	15.2	15.1
1926	14.2	13.9	18.5	19.4	18.9	18.3	17.6	17.1	18.5	17.6	17.1	17.4	17.2
1927	17.7	17.3	14.8	16.3	15.3	13.7	12.9	14.5	15.2	15.4	15.8	15.7	15.7
1928	15.8	16.1	14.9	15.1	14.4	14.6	14.5	16.5	16.3	14.2	14.0	15.2	14.5
1929	14.0	16.3	19.6	17.3	18.7	20.0	18.3	18.4	17.4	17.1	16.0	16.3	17.0
1930	16.2	17.3	15.8	17.3	17.0	16.1	16.6	16.1	16.0	16.0	15.8	13.0	15.9
1931	13.0	12.3	17.5	19.6	15.5	17.6	19.0	20.4	19.2	23.4	20.4	17.4	17.0
1932	16.2	15.8	16.8	19.1	19.6	20.3	22.2	22.4	23.2	......	......	......	......

The ten-year period 1921 to 1930 has been one of relatively favorable feeding ratios compared with earlier years. The average price of a dozen eggs equaled in value 16.9 pounds of poultry ration for the ten-year period. According to the basis used in this report, approximately 8.5 pounds of feed would be required to produce a dozen eggs. Therefore, feed requirements equaled just 50 per cent of the value of eggs during this period.

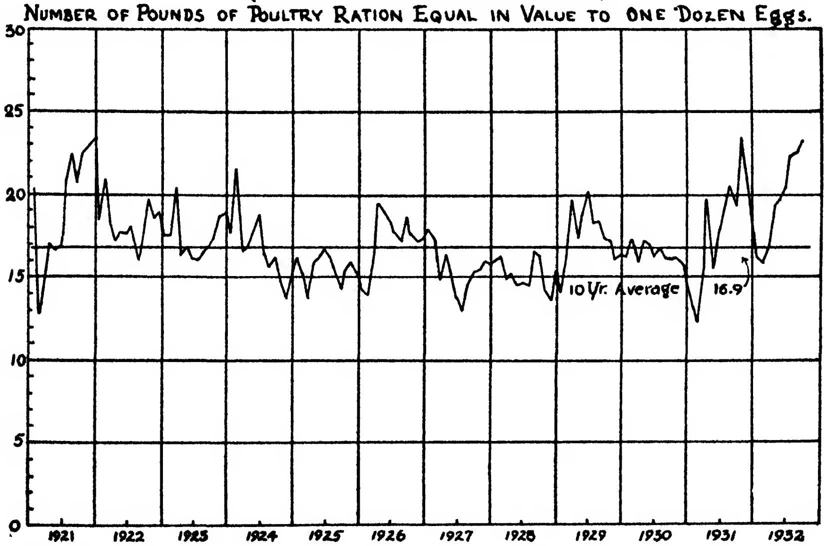
The price of eggs began their downward swing in 1930. The index number of egg prices shows that they dropped over 50 per cent. Feed prices

again lagged but dropped to lower levels. The poultry ratio corresponds to the dairy ratio in that February and October of 1931 had the lowest and highest ratios respectively. The ratio for October shows a dozen eggs equal in value to 23.4 pounds of poultry ration. This is the highest ratio since December, 1921, Graph II.

The year 1932 started with a ratio of feed to egg prices just slightly below the ten-year average. The ratio has steadily widened, partly by falling prices of feed but also by an increase of six cents per dozen from the low point of egg prices. The price of eggs made only the normal seasonal advance of 13.3 per cent from August to September but the feed cost dropped so that the ratio advanced approximately 4 per cent.

September shows a drop in price of eggs of 35 per cent since 1930 but a drop in price of poultry feed of 55 per cent. The situation at the present time is that of a very favorable feeding ratio but with a lower price level for both eggs and feed.

POULTRY FEED-EGG RATIO IN MICHIGAN
(Corrected for Seasonal Variation)
Number of Pounds of Poultry Ration Equal in Value to One Dozen Eggs.



A summary of these feeding ratios shows that the dairy and poultry enterprises are a good market for the feed crops of Michigan farmers. The poultry feed-egg ratio for the first nine months of 1932 has shown a wider margin between the price of feed and eggs than any similar period in the last twelve years. Likewise, the ratio between dairy feed and butterfat prices shows that the dairy cow returned more than market price for feed.

There is a tendency for farmers to place too much emphasis on the present low price level and minimize opportunities for returns in certain enterprises. It is recognized that the net income in these enterprises is low because overhead costs have not decreased in proportion to the drop in prices. Regardless of this situation, the producer has his land, buildings, equipment, and labor which must be utilized to their fullest capacity. The farmer has but few good alternatives in the conduct of his farm business. The question then

becomes one of a choice of enterprises not now on the farm or an increase in intensity or of the size of some of the present enterprises.

A study of these feeding ratios serve as a guide to the producer in planning his farming and feeding operations. He may occasionally make short time adjustments in emphasis on the farm enterprises. This does not mean that it is always desirable to make radical short time changes to follow the periodical fluctuations of feeding ratios. The long-time program which best fits the special physical and market conditions on the individual farm must always be kept in mind. A study of the feeding ratios will then serve as a guide for change of emphasis on the various enterprises.

Similar ratios of price of feed and other livestock and livestock products which will show the comparative advantage of feeding of the different kinds of livestock can be worked out. They will serve as a guide for determining the most desirable of the present enterprises and the possible addition of new ones.

MICHIGAN POTATO COSTS IN 1931

High Yield Table Stock Producers Cut Cost Per Bushel 44 Per Cent

K. T. WRIGHT, SECTION OF FARM MANAGEMENT

One-third of the table stock potato producers cooperating on this farm management study averaged 215 bushels per acre for a net cost of 31 cents a bushel. This was 131 bushels or 155 per cent more potatoes than the low yield group averaged. The total cost per acre on this high yield group averaged $66.02 and was 42 per cent higher than on the low yield group on account of a heavier charge for seed, seed treating material, manure, fertilizers, spray material, and man labor. The net result was a reduction of 44 per cent in the cost per bushel, or from 55 to 31 cents.

There were 94 men completing these potato records in 1931, with practically one-third being located in each of three areas, one area being the northern certified seed potato section, represented by Emmet, Otsego, Charlevoix, and Antrim counties. The second area, on the west side of the state was represented by Montcalm, Mecosta, Kent, and Oceana counties. The third area was represented by Tuscola, Lapeer, and Oakland counties. In this group of 94 men, there was 31 certified seed growers, 22 of which were located in the northern area, 7 in the western, and 2 in the eastern.

Table 1 shows the average results for both the table stock and certified growers for each area for the one year. The northern growers had the best yields, but their acre costs averaged considerably more than the other two areas. The eastern area had the lowest yield but the best price. The margin between the cost per bushel and the value averaged about the same loss for each area last year.

Table 2 shows the 63 table stock producers of 1931 as having an average total cost of $53.88 an acre. The yield was 142 bushels so the cost per bushel was 38 cents, and the potatoes were worth 17 cents the first of December. One third of this cost was direct cash outlay. These men had an average

Table 1.—Production costs of table stock and certified potatoes by areas—1931.

Area	Northern		Western		Eastern	
Kind	Table Stock	Certified	Table Stock	Certified	Table Stock	Certified
Number of farms	10	22	23	7	30	2
Acres in potatoes	8 4	8 3	12 0	14 2	9 7	9 9
Cost per acre	$78 47	$102 97	$48 76	$73 55	$51 56	$66 79
Yield (in bu)	251	233	145	181	108	190
Cost per bushel (cents)	31	44	34	41	48	35
Value per bushel (cents)	16	28	16	23	28	35

of 10.3 acres of potatoes and used 11.6 bushels of seed per acre, which had a value of 80 cents a bushel, and 70 per cent treated the seed. Commercial fertilizer was used by 46 per cent of the men and it was applied at an average rate of 350 pounds per acre. These 63 producers of table stock potatoes spent 32 hours of man labor per acre on the potatoes up to digging, and 28 more hours digging and storing the potatoes. The horses were used an equivalent of 37 hours for one horse in growing the crop and 13 hours harvesting. The tractor was used about two hours on each acre. If all charges except man labor are added together and then subtracted from the credit for the potatoes to get the return per hour of man labor, it will be found that there was a loss of 23 cents for each hour.

The 31 growers of certified seed keeping records in 1931 had a cost of $91.25 an acre. The yield was 213 bushels so the cost per bushel was 43 cents for potatoes having a value of 32 cents December 1. Nearly one-half of this was cash cost, if seed is included as it was with table stock. These growers with an average of 9.7 acres of potatoes used 18.8 bushels of seed per acre which had a value of $1.32 a bushel. About 85 per cent of the certified growers used commercial fertilizer, making an average application of 430 pounds per acre. These men spent 50 hours in growing the potatoes and 44 in harvesting each acre. Horse labor totaled 46 hours growing and 14 in harvesting with 3.7 hours of tractor usage per acre. The return per hour of man labor was minus 16 cents.

The last section of Table 2 shows the average for all farms when both the table stock and certified are combined. The figures for 1930 have been presented in Table 1 along with those of 1931. If a comparison is made between the two years, the following reduction in rates from 1930 to 1931 should be noted: man labor was figured at 20 cents an hour instead of 25 cents; horse labor at 12 cents in place of 15 cents; tractor use charged at 80 cents rather than 90 cents an hour; and general farm expense rate was reduced 30 per cent.

Factors Affecting Yields and Costs

One of the important phases of this farm management study of potatoes is that part having to do with the study of the factors responsible for the variations in yields and costs. The first thing done in connection with this phase of the problem was to sort the farms on the basis of yield per acre and determine the cost per acre and per bushel of potatoes. The variation in the amount of the factors thought to be influential was then determined

Table 2.—Table stock and certified potato production costs per acre for 1930 and 1931.

Items	Table Stock		Certified		All farms	
Year	1931	1930	1931	1930	1931	1930
Number of farms	63	33	31	20	94	53
Growing Costs:						
Man labor	$6.40	$6.74	$10.05	$11.83	$7.55	$8 68
Horse labor	4.45	5.20	5 51	7.04	4 78	5.90
Tractor labor	1 39	1.28	2 69	1 86	1.81	1.50
Machinery	2 28	2.30	4 53	4.95	2.99	3.31
Seed	9 34	11.96	24.88	31.34	14.25	19.35
Barnyard manure	7.04	7.15	5 42	7 05	6 53	7 11
Green manure	.96	1.50	1.10	1 08	1 01	1 34
Fertilizer	3 24	3 42	7.56	10.08	4 61	5 96
Spray material	1.70	1.15	4.65	4 70	2.63	2 50
Seed treating materials	.37	.46	.62	.66	.45	.54
Certification	......	......	1 11	1 57	.35	.60
General farm expense	4.16	5 34	6.64	8.26	4.95	6.46
Miscellaneous	......	......	.03	... ..	.01	......
Total	$41.33	$46.50	$74 79	$90 42	$51 92	$63.25
Harvesting Costs:						
Man labor	5.59	6.63	8 82	8.80	6 61	7 45
Horse labor	1 55	1.79	1.73	2 19	1.61	1 95
Machinery	1.09	1 22	1 68	1 99	1 28	1.51
Miscellaneous	.09	......	.36	.16	.18	06
Total	$8.32	$9.64	$12 59	$13.14	$9 68	$10.97
Taxes on land	1 25	1 13	1 15	1.44	1 22	1 25
Interest on land	2.98	2 88	2 72	2.44	2 89	2.71
Total Cost	$53.88	$60.15	$91.25	$107 44	$65 71	$78.18
Income:						
Potatoes	24 78	59 27	68.59	125 46	38.64	84.51
Profit or Loss	−29.10	−.88	−22.66	18.02	−27.07	6.33
Value per bushel	$ .20	$ .60	$ 27	$1.07	$ .23	$ .82
Cost per bushel	.38	.65	.43	84	.40	74
Acres in potatoes	10.3	8.1	9.7	8 3	10.0	8 2
Yield per acre	142.3	92.2	213.5	128 0	164.7	105.9
Hours man labor	59.4	53.5	94.8	82 5	70.6	64.5
Hours horse labor	49.9	46.7	60.4	61.2	53.2	52 2
Hours tractor labor	1.8	1.4	3.7	2.3	2 4	1.7
Return per hour man labor	−.23	.23	− 16	.45	−.18	.35

to ascertain which were important. The results of this summary are presented in Table 3 where the table stock and certified growers are shown separately. It should be borne in mind that these farms have been sorted on the basis of yield per acre, and not one but several of the factors listed are responsible for the difference in yield.

Factors appearing to have considerable relation to the yield and cost as shown in Table 3 were used for further study. The farms were sorted according to the amount of the particular factor under consideration in an attempt to determine just how much effect each factor had on yields and costs. As in Table 2, the table stock producers and the certified growers were kept separate. Apparently, the abnormal weather conditions of the 1931 growing season caused the effect of the various factors to be much different than it would be under anything approaching normal conditions. The average rainfall for the three areas was about normal until July and

Table 3.—Relation of yields per acre to costs and returns—1931.

Items	Table Stock			Certified Seed		
Yield groups (bu.)	To 100	100–160	Over 160	To 200	200–250	Over 250
Number of farms	22	20	21	11	11	9
Average yield	84.5	129 4	215 3	171.8	228.9	304.9
Acres per farm	11.1	9.2	10.7	13.1	10.2	5.1
Bushels of seed	9.5	10.5	14 8	17.0	20.2	21.2
Cost of seed per bushel	$ .80	$ .78	$ .82	$1.16	$1.46	$1.40
Per cent treating seed	55	70	95	100	100	100
Pounds of fertilizer per acre	122.5	73.2	279.7	258.7	544.5	337.9
Acre Costs:						
Man labor for growing	$5.68	$5.87	$7.60	$8.45	$10.38	$14.27
Cost of seed	7.58	8.18	12.18	19.74	29.58	29.54
Seed treating material	.33	.29	.84	.42	.84	.71
Spray cost	1 36	1.04	2.59	3 79	4 89	7.99
Green manure	.78	1.13	1 03	1.30	.86	1.09
Barnyard manure	5 88	8.81	6 84	5 03	3.71	10.92
Commercial fertilizer	2 88	1 40	5.13	5 47	10.13	7.82
Growing cost	35.70	37 17	50 82	62.21	81.94	96.99
Total cost	46 47	48 84	66.02	77.43	99.16	115.51
Income per acre	16 29	26.45	32.61	51 40	79 94	94.95
Profit per acre	−30.18	−22 39	−33 41	−26 03	−19 22	−20 56
Cost per bushel	.55	.38	.31	.45	.43	.38

August when it was approximately one-half, but in September the rainfall was double normal. The temperature for the growing season averaged over three degrees above normal and was five degrees above in September. These conditions resulted in internal brown spot, and many off-type potatoes, lowering the quality and the value.

From this study on the practices followed, it was found that the table stock producers following at least four of the six practices that were considered most effective in increasing the yields obtained an average yield of 198 bushels, compared to 105 bushels per acre by those following not to exceed one of these practices. It would seem from our study that the major portion of this difference in yield was due to four major factors, which appeared to be of about equal importance. One of these factors was the seed charge per acre. This was dependent upon the quality of the seed, as reflected by the value per bushel, and upon the spacing in the rows and between rows, influencing the bushels used per acre. A second factor was the total charge for manures and commercial fertilizer. Manures in this case included both barnyard and green manures and gave moderate increases while fertilizer improved the yield very much. Spraying was a third factor and was relatively influential on the yields. The fourth factor was the amount of time spent by the farmer on each acre in preparing the seedbed and tending the crop up to digging time.

From a cost standpoint, spraying, and thoroughness of seedbed preparation and care of the crop are the factors that gave the best increases in yield, and consequently are the most likely to show a net return in times of cheap potatoes. While the four factors listed resulted in higher yields, they did not result in lower cost potatoes because the cost of heavier applications of manures, fertilizers, higher priced seed, and other good practices was more than the value of the increased yield in 1931. When the value of the potatoes is more than the cost, those having the higher yields net more profit per acre even though the cost per bushel is about the same on account of having more potatoes to sell above the cost of production.

In this group of 94 farms, there were only nine on which the value of the potatoes equalled all costs of production. These men were all certified growers. A comparison of the average for this group with the average of all certified growers discloses the following points: (a) the yield per acre was 4 per cent more than the certified average, (b) the cost per acre was 6 per cent less, due to small differences on many items, (c) the cost per bushel was 38 cents compared to 43 cents for all certified, and (d) the value of the potatoes was 45 cents compared to 32 cents on account of a higher percentage of U. S. No. 1's, making a net profit of 7 cents a bushel for this group and 11 cents loss for all certified, which makes a difference of over $39 in the net return per acre.

Fig. 1.—The time spent in preparing the seedbed and tending the potato crop is reflected in higher yields and lower costs per bushel.

Suggestions for Reducing the Cost Per Bushel

1. Grow the potatoes only on soils adapted to their production. 2. Use good seed. 3. Fit the seed bed well in order to reduce hand labor and increase the yield. 4. Make economical use of commercial fertilizer. 5. Take good care of barnyard manure and apply it at a moderate rate. 6. Make full use of sweet clover and other legumes as green manure crops. 7. Increase the yield by approved practices in an attempt to reduce cost per bushel. 8. Spray with Bordeaux mixture. 9. Do everything possible to improve the quality. 10. Control machinery expense by (a) doing own repair work, (b) owning machinery in partnership where possible, and (c) use machine best adapted for doing the job at lowest cost. 11. Have the acreage of potatoes such that best use is made of labor, equipment, and other resources. 12. Have the fields large enough to insure efficient use of labor and machinery.

RATIONS FOR FATTENING BEEF CALVES

Annual Report on Feeding Trials Made at Michigan State College

G. A. BRANAMAN, SECTION OF ANIMAL HUSBANDRY

PART I

Corn, Barley, and Oats Compared.

The data presented in this article represent the third experiment at the Michigan Agricultural Experiment Station in which ground barley, shelled corn, and ground oats are compared. Each lot of calves received pea-size linseed cake, corn silage, and alfalfa hay in addition to the respective farm grain.

Methods of Feeding

The feeding period began November 24, 1931, and continued 196 days or until June 7, 1932. Approximately one pound of linseed cake was fed to each seven pounds of grain. About six and one-half pounds of this grain mixture per calf per day was fed the first two months, eight pounds the next two months, and 12 pounds the last two months. The calves in the corn lot were passing more grain undigested the last few weeks and were given a larger allowance. They ate over 14 pounds per day the last two weeks. All the silage which the calves would eat readily was fed twice daily, and hay racks were kept filled with alfalfa hay. A mixture of equal parts of bone meal and salt was always available.

Quality of Feeds

The grains were purchased on the market in car lots, the corn tested 12 to 14 per cent moisture, the oats weighed 32 pounds, and the barley 46 to 48 pounds per bushel. Linseed cake was the old process product containing 37 per cent protein.

Silage grown on the College Farm yielded seven to eight tons per acre, with approximately 35 bushels of corn per acre and was harvested when well dented and glazed. The alfalfa hay was first cutting and varied in quality, some was coarse and stemmy with light mixtures of timothy and blue grass. All the hay was purchased near Lansing.

Description of Calves

Native Michigan calves from grade white-faced cows and sired by registered Hereford bulls were purchased in Sanilac county. Fifty head were sorted from a crop of 90 calves for use in Parts I and II of the experiments here reported. Five steers and five heifers were used in each Lot and sorted carefully according to the usual methods. With few exceptions, all were of choice feeder grade.

Valuations

Price factors are, of course, variable in connection with any experimental feeding results. Actual cost of the calves, which approximated also the cost of similar western calves delivered in Michigan, is used in computing results. Market experts from Detroit and Buffalo markets placed values on

Table 1.—Weights, feeds, and costs.

Five steer calves, Five heifer calves } per lot	November 24, 1931—June 7, 1932 196 days		
	Lot 1	Lot 2	Lot 3
	Ground barley	Shelled corn	Ground oats
	lbs.	lbs.	lbs.
Initial weight per calf	406.1	405 0	406 9
Final weight per calf	830.4	802.2	805 9
Total gain per calf	424 3	397.2	399 0
Average daily gain	2.16	2 03	2.04
Daily feed per calf:			
Ground barley	8 2	......	......
Shelled corn	......	8 4	......
Ground oats	......	......	8 2
Linseed cake	1 2	1.2	1 2
Corn silage	15.6	15 6	15 6
Alfalfa hay	3 0	3 0	3 0
Feed per cwt gain:			
Ground barley	377.1	......	......
Shelled corn	......	413 2	......
Ground oats	......	......	401 0
Linseed cake	57 4	61 3	61 0
Corn silage	720 7	769 9	766 4
Alfalfa hay	139 2	147 0	153 5
Feed cost per cwt. gain	$5 33	$5 76	$5 69
Pork credit per calf at $4 00 per cwt	.42	1 13	46
Feed cost per cwt. gain (crediting pork)	5.23	5 48	5 57
Initial cost in lots per cwt	$7 75	$7.75	$7 75
Initial cost in lots per calf	31 47	31.39	31 53
Feed cost per calf	22 60	22.88	22 69
Cost of calf plus feed cost	54.07	54.27	54 22
Necessary selling price in lots to break even (crediting pork)	6 46	6 62	6 67
Selling price per cwt in lots	6 35	6 35	6 25
Selling price in lots per head	52 73	50 94	50.37
Loss per head (crediting pork)	.92	2.20	3 39

Prices of feeds:
All grains $0.75 per cwt. No charges for grinding Linseed meal $30 00 per ton, silage $3.00 per ton, alfalfa $8.00 per ton, tankage $1.75 per cwt., pork credited at $4.00 per cwt.

the finished cattle. Sixty-five cents per hundredweight was deducted for expense and shrink.

Approximate costs of feeds in sections of Michigan near Lansing during the period of the experiment have been used.

Pigs Help Corn-fed Calves

Pork credits are small in the ground barley and ground oat lots. The low price for hogs makes the pork credits seem almost negligible, however hogs made some return, especially in the shelled corn lot.

Summary

1. The barley-fed calves gained slightly faster than either of the other lots, with no difference between corn and oat-fed calves.
2. The feed cost for each hundred pounds gain on the calves is lowest

for the barley fed calves. The pigs in the corn-fed lot salvaged sufficient corn to make the cost slightly below that of the oat lot.

3. The barley-fed calves and the corn-fed calves were slightly fatter than those in the oat-fed lot and were valued slightly higher by representatives of the Detroit and Buffalo markets. Returns per head were in proportion to the costs of gain and the market values, the latter indicated by gain and finish.

4. Charges for grinding the barley and oats would change their relationship as compared with corn. Ten cents charge per 100 pounds of grain fed would put barley slightly below corn in value and give oats a still greater handicap. It should be noted that the barley and oats were both heavy in test weights and lighter weight products are less efficient feeds.

5. The necessary selling price shows that the calves could have sold at a price over one dollar below the initial cost per hundredweight and still pay for the feed at prices charged in Table 1. Calves produce much cheaper gains than older cattle, as many experiments have shown; otherwise, a margin over cost price would be necessary to pay feed costs.

6. Credits for manure and overhead expenses, such as interest, taxes, and labor, will affect the net returns from cattle feeding in various ways, depending on the individual conditions on each farm. Many cattle feeders consider these items will balance each other in a permanent farm program.

PART II

A Study of Winter Rations for Calves to be Marketed the Following September

Higher prices on the average may be expected for well-finished grain-fed cattle in the fall months than in the spring. Some farmers feed grain through the summer with this market in view, though most cattle are fed during the winter and spring. The question naturally arises as to how long and how well should calves weaned in the fall be fed for such a market. This report gives the results of the third experiment along this line conducted at the Michigan Station.

Methods of Feeding

The feeding period began November 24, 1931, and continued 294 days, until September 13, 1932. The source and description of calves was given in Part I of this report. The feeds were the same quality as described in Part I.

The oat-fed lot of the experiment in Part I constituted Lot 3, the well-fed lot. After June 7, the ration was changed from oats to shelled corn and a full feed continued until September 13.

Lot 4 was given all the silage and alfalfa hay they cared for and one pound of linseed cake in addition to keep them gaining slightly in flesh the first 98 days. After that, the corn was added gradually to make a full feed.

Lot 5 had a full allowance of alfalfa with half a feed of silage the first 98 days. Corn, linseed meal, and silage were then brought to a full feed.

Valuations

The same methods of evaluating the cattle were used as explained in Part I. The same prices for feeds were used, namely: grain at $0.75 cents per hundredweight, linseed cake $30.00 per ton, silage $3.00 per ton,

alfalfa $8.00 per ton, pork credit $4.00 per hundredweight. The marketing expense was raised to $0.75 cents per hundredweight, due to higher cost of shrink on the high cattle market.

Table 2.—Weights, feeds, and costs in first period. Nov. 24, 1931-Mar. 1, 1932—98 days.

	Lot 3	Lot 4	Lot 5
Number calves per lot	10	10	10
Average daily ration:	(pounds)	(pounds)	(pounds)
Ground oats	5 99	......	....
Linseed cake	87	99	....
Corn silage	14 22	18 85	10 28
Alfalfa hay	4 00	6 49	9 57
Average initial weight	406 9	408 0	408 8
Average final weight	591 5	527 0	486 5
Average daily gain	1 88	1 21	.79
Cost per cwt. gain	$5 03	$5 69	$6 77

Table 3.—Weights, feeds, and costs in second period. March 1, 1932-June 7, 1932-98 days.

	Lot 3	Lot 4	Lot 5
Average daily ration:	(pounds)	(pounds)	(pounds)
Ground oats	10 33		
Shelled corn		6 54	6 29
Linseed cake	1 62	1 20	1 03
Corn silage	16 98	25 00	21 31
Alfalfa hay	2 26	2 47	3 35
Average final weight	805 9	730.6	686 9
Average daily gain	2 19	2 08	2 01
Cost per cwt. gain (crediting pork)	$6 03	$5 15	$4 88

Table 4.—Weights, feeds, and costs in third period. June 7-Sep. 13, 1932—98 days.

	Lot 3	Lot 4	Lot 5
Average daily ration:	(pounds)	(pounds)	(pounds)
Shelled corn	13 31	12 06	12.90
Linseed cake	2 00	1 77	1 83
Corn silage	17 10	19.42	19.14
Alfalfa hay	2 44	2.73	2.18
Average final weight	1018 3	945.0	909.5
Average daily gain	2 17	2.19	2.27
Cost per cwt. gain (crediting pork)	$6.94	$6.35	$6 50

Light Ration Expensive

The calves in Lot 5 were fed a limited ration so that at the end of 98 days they were thin but reasonably thrifty in appearance. Their gains were so low, that the cost for each pound of gain was higher than the cost for the calves fed more liberally.

Table 5.—Gains, feeds, and cost entire experiment. Nov. 24, 1931-Sept. 13, 1932—294 days.

	Lot 3	Lot 4	Lot 5
	(pounds)	(pounds)	(pounds)
Total gain per calf	611 4	537 0	500 7
Average daily gain—294 days	2 08	1 83	1.70
Total feed per calf:			
Ground oats	1600	....	....
Corn	1304	1822	1880.
Linseed cake	439	389.	280.
Corn silage	4734	6200	4971.
Alfalfa hay	852	1146	1480.
Total feed cost per calf	$38 88	$33 38	$31 68
Pork credited per calf	1 92	2 50	2 14
Feed cost per cwt. gain	6 36	6 22	6 33
Feed cost per cwt gain (crediting pork)	6 05	5 75	5 90
Initial cost in lots per cwt.	7 75	7 75	7 75
Initial cost per calf	31 53	31 62	31 68
Cost of calf plus feed cost (crediting pork)	68 49	62 50	61 22
Necessary selling price (crediting pork)	6 73	6 61	6.73
Selling price in lots	8 75	8 50	8 25
Return per head above calf and feed costs	20 61	17 83	13 81

During the next 98 days on more liberal feed, Lots 4 and 5 showed lower feed costs for gain than the full-fed calves in Lot 3, although the gain was still faster in Lot 3 during the second period. Lot 3 also held up much better in rate of gain during the last period than has been true in previous trials, yet the cost of gain was slightly higher than for the other two lots. The two lots that were approaching choice grade in finish were gaining more economically than those approaching a prime finish. The lighter weight calves in Lot 5 were more expensive in gains than those in Lot 4, although gaining slightly faster.

A summary of the entire feeding period of 294 days brings to the balance sheet final figures totaling cost of calves, cost of feed, value of pork produced from droppings, and selling value of the cattle.

Summary

1. Gains were in proportion to the quality of the rations.
2. About 50 per cent more total grain per head was consumed in Lot 3, but much less hay than either of the other lots and somewhat less silage than Lot 4. Though Lot 4 ate more silage than Lot 5 they ate less hay.
3. Feed cost for gains was lowest in Lot 4 where the calves had a small amount of grain during the winter. The cost was highest for the full fed calves in Lot 3.
4. Necessary selling prices to pay for feed and calf cost gave Lot 4 a slight advantage with the other two lots equal.
5. Market valuation was highest for Lot 3 and lowest for Lot 5, with the return above calf and feed costs in the same order.
6. If the price of grain is $1.00 per hundredweight, instead of $0.75 cents as was charged, the return per head is approximately equal in Lots 3 and 4. Lot 5 is so far behind, however, that it is almost impossible for them to win out with fluctuating feed prices. It seems desirable to keep the calves gaining in flesh as well as in weight during the winter months.
7. A sharp rise in cattle prices from June to September made summer feeding very profitable in 1932.

LIBERAL VS. LIMITED RATIONS FOR BREEDING EWES DURING WINTER SEASON

Three Years' Results with Upper Peninsula Sub-station Flock

G. W. PUTNAM AND L. H. BLAKESLEE

In many formerly timbered sections of upper Michigan, particularly the Upper Peninsula, there is today a large acreage of grass land and cut-over areas suitable for sheep grazing. This fact has been recognized for the past decade and many inexperienced farmers operating small farms, as well as a few large sheep owners, have made use of formerly waste and non-productive grazing areas. Failure of a few such sheep men to provide sufficient winter roughage and grain has caused several disastrous results.

With the above situation in mind and an increasing demand for information on amount and cost of feed necessary to winter breeding ewes, the following investigation has been conducted.

The location of the Chatham sub-station makes it necessary to put sheep in winter quarters the middle or last of November, due to heavy snowfall. They are usually moved to spring pasture about May 10th. Breeding season starts November 1 and lambs are usually dropped during April, while the ewes are still in winter quarters. The station flock of 175 breeding ewes from which the individuals for the trials were selected is largely of Hampshire breeding.

Since the winter of 1929-30, each year, three lots of ewes have been placed on feed. A total of 234 ewes have been used over the period of three years, with an average of 26 ewes per lot. The three lots were made as nearly equal as possible from the standpoint of age, shearing ability, breeding, thrift, and condition.

These studies were conducted to determine the minimum feed requirements of breeding ewes during the winter season and the effect of a limited ration upon the ewe and her offspring.

Plans for feeding each lot during gestation were as follows:

Lot 1—Full feed of legume hay or approximately four pounds daily per ewe.

Lot 2—Three-quarters ration of legume hay or three pounds daily per ewe.

Lot 3—One-half ration of legume hay or two pounds daily per ewe and approximately an equal amount of oat straw. Except as noted below, all lots were fed the same during the lambing and nursing periods.

The average daily ration and the cost per ewe per day for both the gestation and nursing periods were as follows:

Table 1.—Average daily ration and cost.

	Lot 1			Lot 2			Lot 3			
	Hay lbs.	Grain lbs.	Cost cents	Hay lbs.	Grain lbs.	Cost cents	Hay lbs.	Straw lbs.	Grain lbs.	Cost cents
Gestation period..........	4.05	.399	1.83	3.02	.51	1.37	1.98	1.73	.51	1.29
Lambing and nursing periods................	4.07	.725	2.26	3.97	.714	2.21	3.82	......	.718	2.20

NOTE:—Lot 1 was fed grain the entire gestation period the first year. Other years all lots were grained five weeks before lambing, as were Lots 2 and 3 the first year.

For computing feeding cost, the following prices were used: hay, $8.00 per ton; farm grains, $15.00 per ton; protein supplements, $30.00; mineral and salt, $1.60 per cwt.; straw, $4.00 per ton.

All roughage not consumed by the ewes was weighed back daily. During the gestation period, Lot 1 left in the racks .37 pounds of hay per head daily. The actual consumption of hay was therefore 3.68 pounds per head daily. Practically no hay was left by Lot 2 which received three pounds daily per head. Lot 3 refused .54 pound of roughage daily only a very small amount of which was coarse hay stems leaving a net daily consumption of approximately two pounds of hay and one and one-fourth pounds of straw.

The variation in the three rations made considerable difference in the average gain per ewe in the respective lots. The average initial weight, the weight at the end of gestation period, weight when turned to pasture, and weight at weaning time are shown in Table 2.

Table 2.—Ewe weights and gain or loss during different periods.

	Lot 1	Lot 2	Lot 3
	(pounds)	(pounds)	(pounds)
Average initial weight	141 468	139 227	139.456
Average weight at end of gestation period	163 089	151 030	147 947
Gain during gestation period	21.620	11 800	8 490
Average weight when turned to pasture	128 116	125 215	118 464
Loss during lambing and nursing period	34.973	25 820	29 483
Average weight at weaning time	137 644	133 195	137.760
Gain on pasture to weaning	9 528	7 980	21.296
*Average fleece weights	6 890	6 430	6.480

*The ewes were sheared before going to pasture thus the loss previous to pasture is not entirely due to partutition and nursing.

While Lot 1 presumably receiving the better ration made a much larger gain during the gestation period, they lost more weight while lambing and gained less on pasture. All three lots weighed approximately the same when their lambs were weaned, indicating that anyone of the three rations used were satisfactory in maintaining the ewes over a period of years.

Table 3.—Weight of lambs at birth and when weaned.

	Lot 1	Lot 2	Lot 3
	(pounds)	(pounds)	(pounds)
Average birth weight of twins	8 61	8 25	8 1
Average birth weight of singles	9 6	10 38	9 19
*Average daily gain to weaning time (twins)	439	.410	.418
*Average daily gain to weaning time (singles)	491	497	481
Average weight of twins at weaning time	58 42	56 5	56 36
Average weight of singles at weaning time	65 229	67.21	62.00

*These figures were computed by deducting the birth weight from the weaning weight.

All three lots produced an excellent crop of lambs, as an average of the three years, Lot 1 gave birth to 154 per cent of living lambs, Lot 2 to 147 per cent and Lot 3 to 151 per cent. Though there was a slight difference in the birth weight of the lambs from the different lots, there was practically no difference in their strength and vitality. Both the twin and single lambs from each lot made satisfactory gains from birth to weaning time, indicating

that there was little, if any, difference in the milk producing ability of the ewes in the three lots.

Owing to the difficulty of maintaining separate lots during the mating season, these records were not started until after the ewes had been in winter quarters 20 days.

The cost of maintaining each breeding ewe in the respective lots during the progress of these tests was $2.98 in Lot 1, $2.33 in Lot 2, and $2.25 in Lot 3.

If we add to the above cost of wintering 20 days feeding at the rate given in the first line of Table 1, then the total feed cost of wintering the breeding ewes would be $3.34 per head in Lot 1, $2.60 per head in Lot 2 and $2.58 per head in Lot 3, no charge being made for the labor, shelter, or use of cut-over pasture on which the flock was grazed during the summer.

The cost of carrying breeding ewes over the winter depends very largely upon the length of the feeding season required and the time at which the lambs are born. If the lambs are not born until after the ewes go out on pasture, then the total feed cost of carrying the breeding ewes through the winter may be obtained by multiplying the daily feed cost given in Table 1 by the number of days of winter feeding required.

While on pasture the entire flock, including both ewes and lambs, were treated at three to four weeks' intervals with Black Leaf 40—copper sulphate solution as a means of preventing infestation with parasites.

Summary

1. Certain areas of upper Michigan pasture land can be utilized by sheep when a good market is available.
2. Provision for producing or procuring winter feed should be made in planning a sheep enterprise.
3. Ewes can be wintered on a limited ration of roughage when grain and a good quality hay are provided previous to and during lambing, or if lambs are dropped late on pasture.
4. Provision should be made for controlling internal and external parasites in the ewe and lamb flock. Detailed information can be procured from Michigan State College, Animal Husbandry Department, East Lansing, Michigan, or Upper Peninsula Experiment Station, Chatham, Michigan.

Additional information available at Bulletin Room of Michigan State College:

"Sheep Raising In the Upper Peninsula"—Extension Bulletin No. 86.
"Lamb Production In Michigan"—Extension Bulletin No. 113.
"Quality Lamb Production"—Extension Bulletin.

"MICHIGAN GOLDEN"

A New Celery Resistant to Yellows

RAY NELSON AND L. C. COCHRAN, BOTANICAL SECTION

Under normal conditions, the value of the Michigan celery crop exceeds $2,500,000 annually. Celery produced in certain sections of the state has become nationally famous. Kalamazoo, the birthplace of the celery industry

in Michigan, has long been renowned for the production of high quality celery which may be found in season on the menus of fine hotels and dining cars in all sections of the country. Because of the intensive methods of production at Kalamazoo and other summer celery districts, diseases are especially important and are a periodical threat to the industry. The appearance of celery yellows, also known as root rot, crown rot, stunting and "sickness" at Kalamazoo about 1908-10 has made increasingly difficult the production of high quality celery for which this area has long been famous. The disease was especially destructive in 1931 and 1932 and the losses to Kalamazoo growers alone in 1931 exceeded $100,000.

Brief History of Yellows in Michigan

Yellows was first observed by plant pathologists of Michigan State College in what is known as the south marsh celery district of Kalamazoo during the summer of 1913. The following year the disease was localized in a few fields in that section. In an attempt to eradicate the disease, the affected areas in some fields were sterilized in 1914 by means of high pressure steam. In June, 1916, Axel Creek, which flows through the south marsh celery section, overflowed its banks and more than a hundred acres of the best celery land in Kalamazoo were inundated and inoculated with the causal fungus of yellows carried in soil washed from affected fields.

In all the flooded fields, yellows was very serious in the summer of 1916. During the next three years, this disease spread to the north marsh section and to Portage and Comstock. Shortly afterward the disease appeared at Muskegon, Grand Haven, and the winter celery sections of Hudsonville and Decatur. In the winter celery sections, yellows has never been so destructive because of the less intensive methods of production and higher water tables. Yellows thrives at high soil temperatures and the lowering of the water table at Kalamazoo by many deep driven municipal wells has undoubtedly contributed to the increasing prevalence of the disease in recent years.

Control of Yellows by Use of Resistant Varieties

Prior to 1919, in Michigan, the dwarf strain of Golden Self-Blanching celery was grown almost exclusively. As soon as the nature and cause of yellows was determined, it was recognized that the only successful method of controlling the disease would be to use varieties naturally resistant or to breed resistant strains by means of selection. The so-called easy blanching variety, Newark Market, was extensively grown for several years beginning about 1919. This variety, like other green sorts, was naturally resistant to yellows under conditions where the yellow kinds would fail. Because of the slow blanching qualities of this variety it was never popular with the growers but as an emergency sort it proved extremely valuable in the Kalamazoo section. Success of growers with the tall strain of Golden Self-Blanching, which appeared about 1922, led to its immediate adoption as the leading commercial variety.

Golden Plume (Wonderful) appeared at about the same time and has been extensively used in sections where yellows is prevalent. Due to generally favorable growing conditions in the years previous to 1930, neither of these varieties was subjected to critical field tests for resistance to yellows. Previous to 1930, both varieties, with some exceptions, grew well in soil where the dwarf strain of Golden Self-Blanching had previously been grown and succumbed to the disease.

Selection work to obtain resistance in the dwarf strain of Golden Self-Blanching was begun in 1919. Fields were sought in which practically all of the plants were affected with or killed by yellows. Such fields were not difficult to find but the early work was complicated by the large number of green rogues present in most plantings of this variety. All of these green plants were resistant but were undesirable on account of inferior blanching qualities. In September, 1919, five plants were secured from a field originally set to 12,000 plants of dwarf Golden Self-Blanching. These five plants were the sole survivors with the exception of green rogues. Four of these selections were destroyed by soft rot during the winter but the fifth plant produced about one-half an ounce of seed in June, 1920. When grown in inoculated soil at temperatures very favorable for yellows, this

Fig. 1.—Comparative resistance to yellows of tall strain Golden Self-Blanching, "Michigan Golden" and Golden Plume, 1932. Left—3 rows of tall Golden ruined by yellows; center—1 row of "Michigan Golden" 100 per cent resistant; right—Golden Plume, about 50 per cent diseased.

strain was highly resistant to the disease. By further selection, seed of a highly resistant strain produced from this selection was ready for release to growers in 1925. While this work was in progress the tall strain of Golden Self-Blanching had appeared and was being successfully grown at Kalamazoo and other sections where yellows was formerly prevalent. The rapid blanching of the tall strain in comparison with the slower blanching of the dwarf was an outstanding quality in its favor. As a consequence, the resistant strain of dwarf Golden Self-Blanching was looked upon with disfavor and has never been widely used.

For several years after the appearance of the tall strain, little trouble was experienced with yellows. Not until 1929 were temperature and moisture conditions favorable for yellows. The disease became increasingly serious in 1930 and in 1931 under especially favorable temperature conditions yellows caused a loss of $250,000 in the State. Not until 1929 was an opportunity afforded for making field selections from plantings largely de-

stroyed by yellows. In 1929, several selections were made from plantings seriously affected but all of these plants were destroyed by soft rot in March and April of the following year. In 1930, 14 selections were made from a number of fields at Kalamazoo in which a high percentage of the plants were destroyed by the disease. Only one of these plants was carried through the winter successfully and into seed production. Immediate tests in inoculated soil demonstrated the high resistance of the progeny in the seedling and later stages of growth. Subsequent tests in the greenhouse and field tests at East Lansing and Kalamazoo have shown the great resistance of the se-

Fig. 2.—A bunch of "Michigan Golden" celery grown at Kalamazoo, 1932.

lected strain to yellows. Less than one per cent of the plants have been infected even under the most favorable conditions. Tests just completed of the second generation selfed line have shown no breaking down of this high degree of resistance.

In addition to high resistance to yellows, "Michigan Golden" possesses very desirable commercial qualities. It is intermediate in type between tall Golden Self-Blanching and Golden Plume, the foliage characters being more nearly like those of Golden Plume and the stalk characteristics similar to those of the tall strain. There is, however, some variation in this character, some of the plants producing stalks more like those of Golden Plume than

of tall Golden Self-Blanching. Further selection work will be carried on to fix the most desirable stalk characters of the strain. The emergency demands of the present situation have made it necessary to release seed of this strain for the benefit of growers who can no longer grow commercial varieties of yellow celery. This strain should prove very valuable at this time to Michigan growers. It retains all of the desirable blanching qualities of the tall strain and produces an unusually heavy heart which is practically self-blanching. Only a limited quantity of seed is available for distribution and only growers who have experienced trouble in growing commercial strains of yellow celery should substitute "Michigan Golden" for those sorts. Seed may be obtained in small quantities from the Grand Rapids Growers' Association, Grand Rapids, Michigan.

Comparative Resistance of Celery Varieties

From time to time during the past 10 years, new commercial varieties of celery have appeared and have been heralded as resistant to yellows and sold at high prices to harassed growers. Most of these varieties and strains have failed under critical test in the field. Some have been notoriously susceptible although sold as highly resistant sorts. In observations for more than 15 years, no commercial variety of yellow celery has stood up under field conditions in seasons especially favorable for yellows. Some sorts have done well under so-called normal conditions, and, in seasons when rainfall is abundant and soil temperatures are comparatively low, even very susceptible varieties produce satisfactory crops. The apparent resistance shown by the tall strain of Golden Self-Blanching previous to 1929 is, in our opinion, to be explained, at least in part, by the general incidence of weather conditions unfavorable for yellows. The drought and high temperatures which characterized the seasons of 1930 and 1931 provided conditions which were especially favorable for yellows and all strains of yellow celery were seriously affected. Semi-resistant varieties like Golden Plume became badly diseased in 1932 and the resistant green varieties were also affected. From obserations, the following arrangement represents the reaction to yellows in the field of the varieties of celery grown in Michigan, placed in the respective order of their susceptibility and resistance:

Very Susceptible	Susceptible	Moderately Resistant	Highly Resistant
Golden Phenomenal	Florida Golden	Easy Blanching (Newark Market)	"Michigan Golden"*
Hoover Special	Golden Prize	Early Fortune	M. S. C. strain dwarf Golden Self-Blanching
Tall strain of Golden Self-Blanching		Golden Plume (Wonderful)	
Dwarf strain of Golden Self-Blanching		Golden Detroit	

SEDIMENT IN HOMOGENIZED MILK

G. MALCOLM TROUT AND C. P. HALLORAN, SECTION OF DAIRY HUSBANDRY

Although the practice of homogenizing market milk is still new, it is one of the growing advancements in the market milk industry. At the present time, the homogenization of the market milk supply is somewhat limited throughout the United States; however, it is a process which is receiving increasing attention from the milk dealers, some of whom are seriously considering homogenizing a part of their milk supply.

Homogenization consists in forcing the liquid, usually at temperatures ranging from 130° to 160° F., through a small orifice under a pressure ranging from 500 to 4,000 pounds per square inch. Such treatment reduces the fat globules to a small fraction of their original size.

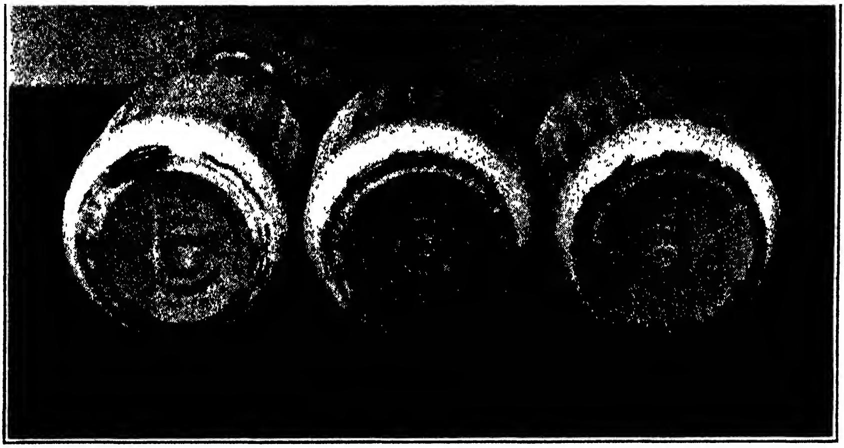


Fig. 1.—Pressures of homogenization appear to have little effect upon the amount of sediment settling out. The pressures used were 1,500, 2,500, and 3,500 pounds per square inch respectively, at 145° F.

Homogenized milk shows no cream layer, the fat being uniformly dispersed throughout the serum. The primary purpose of homogenizing milk, therefore, is to render the milk homogeneous so that the fat can not be removed as cream. The importance of this is evident where dipped milk is permitted in restaurants and hotels, and in homes where the cream is poured off for use in coffee and the remaining less rich milk is given to the children.

Those practicing homogenization of the milk supply have observed from time to time a defect in the bottled product which is often so evident as to merit serious complaints from their customers. This defect appears as a smudgy, dirty deposit in the bottom of the bottle after the milk has been held at low temperature for 24 to 48 hours. The amount of this deposit varies greatly. Sometimes, it manifests itself as a very fine, hair-like ring at the base and side of the bottle from 1/16 to 1/8 of an inch from the

bottom. Occasionally, it is so serious as to give the bottom of the bottle a dark appearance. In such cases, the discolored material may occur in several forms. It may be evenly distributed over the entire surface, may be flocculent, or may be chunky. The distribution of this material depends to some extent upon the position of the bottle during storage. The color ranges in intensity from a reddish-brown to a greyish-green or a grayish-black. Generally, the gray color predominates. This material readily remixes with the milk upon slight shaking of the bottle, after which it does not resettle for some time.

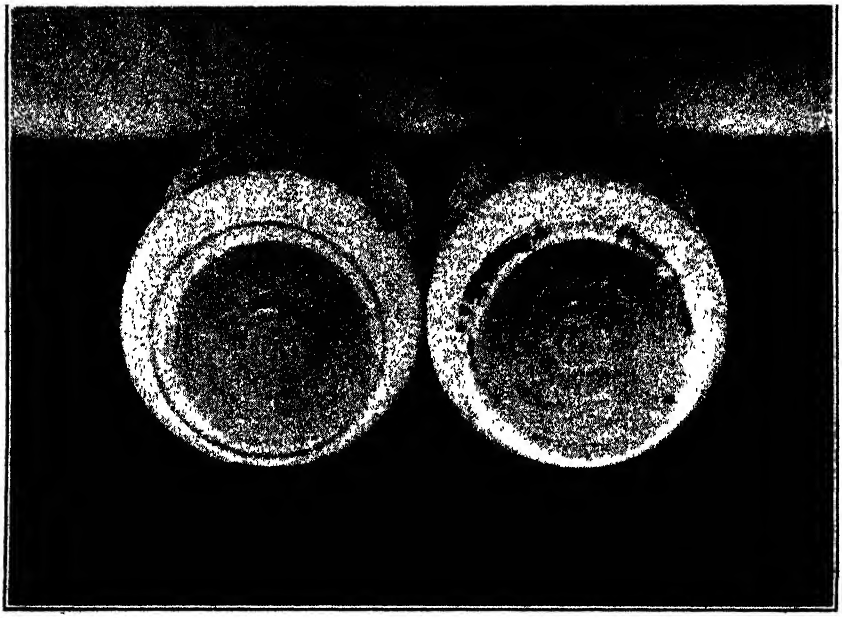


Fig. 2.—A form of sediment appearing in a sample of homogenized filtered milk. The milk at the left is a check unhomogenized sample.

The readiness with which the deposit mixes into the milk and its characteristic color suggested that possibly it was composed of minute particles of broken down valve packing plus some soiled milk solids from the piston rods. However, some later tests showed that the deposit had little or no relationship to worn valve packings.

When sediment discs were secured from pint samples of the mixed milk which had shown a deposit, the sediment discs were clean and were in no way indicative of the nature of the milk from which the discs were taken. The sediment was so fine that it passed readily through the disc.

By syphoning the liquid above the sediment and concentrating the material from 80 quarts of milk in which the defect was quite apparent, some of the material was obtained, dried, and examined under the microscope. Before drying, the material appeared as very dirty separator slime. After drying, it was quite hard and tenacious. Under the microscope, it appeared to be composed of extremely fine silt which was possibly associated to some ex-

tent with the proteins of the milk. These dirt particles ranged from two to 10 microns in size and were irregularly shaped.

In all cases where this defect appeared, the check unhomogenized sample showed a clear white bottom to the bottle. If any sediment specks did appear, they were coarse and of sufficient size to be filtered out.

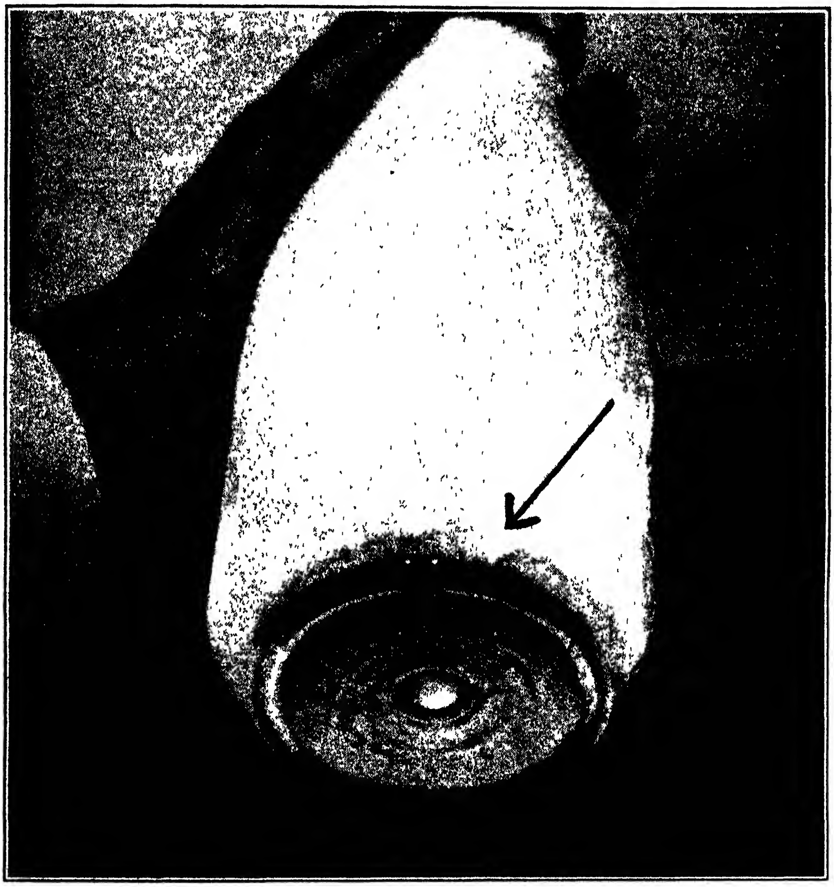


Fig. 3.—The sediment readily remixes into the milk with slight agitation. The rim of the sediment ring has broken away due to the slight incline at which the bottle was held.

Trials were run to see whether the pressure of homogenization had any influence upon the amount of sediment settling out of the milk. Pressures of 1,500, 2,500, and 3,500 pounds per square inch were used at 145° F. with no consistent difference showing between any two pressures.

Even when the milk was filtered through two thicknesses of filter cloth and then homogenized, the defect was very evident after 24 hours. It appeared practically as intense as that in the unfiltered homogenized sample.

Hand clarified homogenized milk showed a much less intense defect than

the filtered homogenized milk after holding 24 hours while 18 samples of six lots of power clarified homogenized milk showed no sediment after 24 hours, a trace after 48 hours, and considerable after 72 and 96 hours at 35° F. The sediment, however, had a different character, being fine and lighter in color.

One of the early theories regarding creaming of milk was that as the larger fat globules rose through the milk they carried along, through adsorption, the smaller globules and any fibrinous matter suspended loosely in the milk. It is not improbable, therefore, that with a lack of creaming as the result of homogenization any silt present might readily settle out together with some casein or milk cells. It is also probable that the rigorous treatment of the milk incident to homogenization might reduce the size of the sediment particles to the extent that they would appear as a smudgy deposit at the bottom of the bottle.

The defect described appears to be a very fine dirt probably in a mixture with some milk solids. Extreme cleanliness during the production and subsequent handling of the milk, especially in dry weather, seems necessary to keep the defect at a minimum in the homogenized product. Power clarification seems to eliminate the defect for 24 hours and retards its sedimentation for 48 hours. Keeping the milk cold seems to retard the formation of the deposit.

With the present growing interest in homogenization and the many advantages which can be claimed for homogenized milk, there is no doubt but that additional attention must be given to some of the factors affecting the development of a satisfactory product.

The authors wish to acknowledge the cooperation and helpful suggestions of Mr. W. A. McDonald, McDonald Dairy Co., Flint, Michigan; Mr. W. F. Jones, Ottawa Dairy, Ltd., Ottawa, Ont.; Mr. A. H. White, Canada Department of Agriculture, Ottawa, Ont., and Col. C. M. Ruttan, City Dairy Co., Ltd., Toronto, Ontario.

ASPARAGUS FERTILIZER TESTS

Influence of Varying Amounts and Time of Application

H. L. SEATON,* HORTICULTURAL SECTION

Asparagus is a heavy feeder and the nature of the sandy soils in sections of Michigan, where the crop is grown on a commercial scale for the canning factory and for market in the fresh state makes the fertilizer problem one of the most acute questions with which the growers are confronted. Profitable long-lived plantings which produce a large percentage of spears ¾-inch

*This experiment was outlined and carried through the 1929 season by J. B. Edmond.

and over in diameter with the addition of little or no manure depend largely upon the proper use of commercial fertilizers.

The experiment here reported was conducted for the purpose of securing information on the influence of varying amounts and the time of application of fertilizers to asparagus. This material along with a brief summary of the data available from other Experiment Stations is presented for the benefit of the growers in solving their fertilizer problems with the crop.

Plan of the Experiment and Methods

The plants used in this experiment were grown from seed listed as a re-selected stock of the Mary Washington variety. The seed was sown about 3 inches apart in rows 18 inches apart in the spring of 1925. Several applications of nitrate of soda were made at intervals during the growing season. The crowns were dug the last week in April, 1926, and were held in cold storage at a temperature of 40° F. until planting. They were rigidly graded and only the largest were planted. On May 12 and 13, the crowns were set in the permanent planting at a depth of about 10 inches and 2½ feet apart in rows 5 feet apart. The plantation was cultivated frequently throughout the growing season in order to control weeds and gradually to fill up the trench made at planting time.

The soil of the plantation ranged from a clay loam to a sandy loam and was not uniform throughout the planting. It had been previously devoted to a general line of field crops and was rather low in fertility. The surface soil was rather shallow but the entire area was well drained. Tests showed that the soil was medium to strongly acid with a lime requirement of approximately 2½ tons per acre. However, no lime, manure, nor commercial fertilizer was applied at the time of planting.

The planting consisted of eleven rows approximately 500 feet long. The outer rows and the ends of all rows were considered as buffer rows and were not included in the experimental plots. The central row was also used as a buffer between the various plots, so that each plot consisted of four rows—50 feet long and was bounded on all sides by buffer rows The area per plot was 1,000 square feet or 1/43.56 of an acre. Six treatments were employed and each of these was replicated three times in widely separated plots making a total of eighteen plots. The treatments were as follows:

1. Check—no treatment.
2. *4-8-6—600 pounds per acre. Applied at the end of the cutting season.
3. 4-8-6—1,200 pounds per acre applied at the end of the cutting season.
4. 4-8-6—1,200 pounds per acre—600 pounds applied before growth started in the spring and 600 pounds at the end of the cutting season.
5. **4-8-6—1,200 pounds per acre applied at the end of the cutting season plus cover crop of oats seeded about August 1.
6. 4-8-6—1,800 pounds per acre applied at the end of the cutting season.

*A 4-10-6 analysis of fertilizer was used on all fertilized plots in 1931 and 1932 in place of the 4-8-6.

**Discontinued in 1931 as the vigorous growth of tops shaded soil too much for satisfactory growth.

The plants did not make a satisfactory growth during the 1926 season, probably on account of the low state of fertility of the soil. In 1927, the fertilizer treatments were applied to all plots and the cover crop seeded. The growth of the plants in 1927 did not warrant a cutting in 1928 but the growth made that season was more satisfactory and a light cutting was made in 1929. The harvesting periods for the succeeding years were as follows:

1929—May 10 to May 31.
1930—May 4 to June 4.
1931—April 25 to June 13.
1932—May 10 to June 13.

At the end of the growing season each year, the tops were allowed to remain on the plants over winter and were disked into the soil at the first cultivation in the spring. This system added some organic material to the soil each season.

Results

Records were kept of the weight of marketable spears from each plot at each cutting throughout the harvesting periods. The spears were not graded, as fully 90 per cent could have been classed as meeting the requirements of the U. S. No. 1 Grade. 1930 and 1931 were unusually dry seasons which no doubt reduced the yields materially. The figures for the first four cutting seasons reported in Table 1, are the averages or the means of the three replications of each of the treatments. These were used in calculating the acre yields also given.

Discussion of Results

Slight variations in the yields of the various experimental plots, as compared with that of the check, are insignificant and may be attributed more to soil variations than to the influence of the fertilizers applied. This is particularly true of the 1929 and 1930 data. However, the data as a whole give certain indications that may lead to the following generalizations:

1. All treatments increased the total yields of the plots over that of the check and this was particularly pronounced as the plants became older. In all treatments the percentage increase over the check increased significantly each year for the four seasons reported.
2. The data indicate that approximately 1,200 pounds of a 4-8-6 or 4-10-6 fertilizer is the most economical amount to apply on this type of soil.
3. The greatest returns were secured in this experiment where divided, spring and summer, applications were made.
4. The growing of a cover crop of oats in the young plantation gave a significant increase in the later yields on the plots where it was used.

Results of Fertilizer Experiments at Other Stations

The data bearing upon the fertilization of asparagus, as reported in the literature, are rather conflicting and generally inconclusive. Results of experiments in Massachusetts seem to show that on a sandy loam soil chemical fertilizers produced as large yields as 10 tons of manure either

Table 1.—Influence of different amounts and of time of application of fertilizer to asparagus.

Treatment	Year	Yield pounds		Increase over check	
		Average per plot	Calculated acre yield	Pounds per acre	Per cent increase
Check—No treatment	1929 1930 1931 1932	35 86 45 92 42 52 65 02	1562 06 2000 13 1852 17 2832 27	....	....
Total	...	189 32	8246 63	..	....
4-8-6 fertilizer, 600 lbs. per acre after cutting season.	1929 1930 1931 1932	30 33 44 67 46 15 75 92	1321 17 1945 68 2010 29 3307.07	−240 89 − 54 45 158 12 474 80	−15 42 − 2 72 8 75 13.23
Total	.....	197 07	8584 21	·337.58	4 09
4-8-6 fertilizer, 1,200 lbs. per acre after cutting season.	1929 1930 1931 1932	32 08 53 08 54 85 85 84	1397 40 2312 31 2389 26 3739 19	−164 66 312 18 537 09 906 92	−10 80 15 61 29 00 32 02
Total		225 85	9838 16	1591 53	19 30
4-8-6 fertilizer, 1,200 lbs per acre after cutting season plus cover crop of oats	1929 1930 1931 1932	40 00 58 42 57 61 97 83	1742 40 2544 63 2509 49 4261 47	180 34 544 50 657 32 1429 20	11 54 27 23 35 48 50 45
Total	. .	253 86	11057 99	2811 36	34 08
4-8-6 fertilizer, 1,800 lbs. per acre after cutting season.	1929 1930 1931 1932	36 13 56 59 64 65 101 73	1573 82 2465 06 2816 15 4431 36	11 76 464 93 963.98 1599 09	.75 23 25 52.05 56.46
Total	.....	259 10	11286.39	3039 76	36 85
4-8-6 fertilizer, 1,200 lbs. per acre, 600 lbs. before and 600 lbs. after cutting season.	1929 1930 1931 1932	45 16 60 85 73 06 120 36	1967 17 2650 62 3182 49 5242 88	405 11 650 49 1330 32 2410 61	24 01 32 52 71 83 85.12
Total	......	299 43	13043 16	4796 53	58 16

used alone or in combination with chemical fertilizers. Similar results were secured in Maryland on a medium loam soil. In the latter experiment, 20 tons of manure gave the largest yields but not the largest net returns. The second highest yield was produced by applications of 400 pounds of dissolved rock, 400 pounds of Kainit, and 200 pounds of nitrate of soda per acre and this was considered the best fertilizer to use under Maryland conditions. These and other experiments indicate that manure is not of great importance and may be replaced by chemical fertilizers, although the experiences of some growers do not seem to support this idea. On the other hand, exceptionally good yields of spears have been produced where no organic matter other than the old asparagus tops have been added in combination with commercial fertilizers.

Most of the experiments conducted in the Eastern States where soil and climatic conditions are similar to those of Michigan indicate that between 1,000 and 1,500 pounds of fertilizer is the most economical to apply. The evidence in general further indicates that nitrogen and potash are needed in larger amounts than is phosphorus. The best sources of potash seem to be the muriate of potash or kainit rather than the sulphate of potash and that nitrate of soda is a better source of nitrogen for asparagus than sulphate of ammonia. Increases in yield have been secured on heavily manured fields with the use of nitrate of soda but the increases from phosphorus and potash under these conditions have not been significant.

The time to apply fertilizers to asparagus has been much debated. Experiments in Delaware and Massachusetts have shown that applications of nitrate of soda during the cutting season could not be recommended. Maryland and Massachusetts results indicate that spring applications of fertilizer are better than those made at the end of the cutting season. Under most conditions spring applications seem to be preferable to summer applications, especially for the phosphorus and potash. Some authorities recommend that the nitrogen application be divided and part applied in the spring and part at the end of the cutting season. If all the fertilizer is applied at the end of the cutting season, often long periods of dry weather may occur and the fertilizer is not available until too late in the season to be of any value in increasing the yield of the next seasons crop.

Recommendations

As has been pointed out during the period from the time the experiment reported here was started and the present time, considerable experimental data have been published upon various phases of the fertilization of asparagus. In this particular experiment, it was not possible to check most of these items although work of this nature is planned for the future. The following recommendations are based largely upon the data referred to and the actual results that have been secured by Michigan growers.

In general, the character of the top growth made by the planting after the cutting season is over may be used as a good indicator of the crop the following spring; that is, a vigorous growth that is uninjured by rust or drought is usually an assurance of a good crop of marketable spears the next spring. It is now generally agreed that there is little loss by leaching of the phosphorus and potash applied in chemical fertilizers and since there is danger of dry weather after July 1st, when these materials may not become available to the plants, the phosphorus and potash should be applied at the first cultivation in the spring and disced into the soil. Apparently, the failure of the

spears to stand up well after they have been cut and packed, a trouble experienced by some growers on the lighter soils, may be generally overcome by larger applications of potash in the fertilizers. In order to secure the most benefit from nitrogenous materials, one-fourth to one-half of the nitrogen should be applied in the form of nitrate of soda along with phosphorus and potash in the spring and the remaining one-half or three-fourths should be applied in the form of sulphate of ammonia after the cutting season. Where the latter material is used for several years it is generally advisable to apply lime or marl every 3 to 4 years to correct the acidity produced.

On light sandy soils from 400 to 600 pounds per acre of a 2-8-10 or 3-9-18 fertilizer is recommended for the canning crop and from 800 to 1,200 pounds of the same analysis for the crop grown for market in the fresh state. This should be applied and disced into the soil before growth starts in the spring and after the cutting season an application of 200 to 300 pounds per acre of sulphate of ammonia should be made. Lime should be applied when soil tests show a need for it. On the heavy sandy loam and loam soils, a 4-10-6 analysis is recommended plus a post-cutting season application of 150 to 200 pounds of sulphate of ammonia.

TRENDS IN PEACH PRODUCTION

With Special Reference to Michigan Conditions

F. C. BRADFORD, SECTION OF HORTICULTURE

The census of 1930 shows, in comparison with that of 1920, a tendency toward decreases in numbers of fruit trees and vines, continuing the general decrease occurring from 1910 to 1920. In the last decade increases in bearing trees have occurred in pears, in plums and prunes, in cherries and in grapes. In trees not of bearing age, the only increase found is in cherries and pronounced decreases have occurred in apples and in plums and prunes.

Michigan in 1930 had more cherry trees and grape vines, old and young, than it had in 1920; otherwise, decreases have occurred. Its trends, therefore, are in general agreement with those of the country at large, except as to pears and plums on the one hand and bearing cherry trees and young grape vines on the other.

Deductions from these figures should, however, be made with extreme caution. Commercial crops have not decreased with number of trees; in most cases they have either maintained their levels or increased. Furthermore, not all plantings are equally competitive, since marketing periods do not coincide and shipping conditions vary.

This complexity is illustrated by the peach.

From a Michigan peach grower's point of view, other peach-producing areas are either nön-competitive or competitive in varying degree. One of

Table 1.—Fruit trees and vines (in units of 1,000 trees) in the United States, according to census reports.

	Not of Bearing Age		Bearing Age	
	1930	1920	1930	1920
Apples	27,455	36,195	88,849	115,309
Peaches	20,134	21,618	58,912	65,646
Pears	5,228	6,052	16,043+	14,647
Plums and prunes	4,514	9,375	29,309+	20,452
Cherries	4,615+	3,695	8,381	10,788
Grapes	24,653	27,394	342,191+	225,754

the two leading peach states, California, has an impressive acreage devoted extensively to canner's peaches, not advantageously diverted to the fresh fruit trade and is not ordinarily an important factor in eastern fresh-fruit markets.

Competitive states may be considered in two groups: (1) those whose crops considerably overlap Michigan's in time of ripening and (2) those whose crops mostly precede Michigan's in maturity but to some degree fill requirements for home canning and satiate Michigan's logical trade territory before the Michigan crop is mature. These groups are roughly indicated in Table 3. Michigan does not feel the full impact of either group but is not unaffected by either. A short crop in Washington, for example, besides affecting that state's crop, diminishes pressure from Colorado and Utah on the Chicago market. The effects of short or heavy crops in Illinois are well recognized in prices for Michigan peaches.

Apparently, then, though there were in the country as a whole about 1,500,000 fewer trees not of bearing age in 1930 than there were in 1920, the states that compete most closely with Michigan, had actually more. In fact, if Georgia is removed from consideration, the total for the United States was greater in 1930 than in 1920.

In bearing trees the country as a whole showed a decrease of over 6,500,000 between 1920 and 1930. To this loss Michigan contributed 1,250,000, leaving 5,250,000 decrease for the rest of the states. Among the states of more immediate concern to Michigan, New York had the greatest decrease, which was, however, more than offset by the increase in Illinois, and the total numbers of bearing trees for the competing states, with Georgia included or omitted, was greater in 1930 than in 1920.

Table 2.—Fruit trees and vines (in units of 1,000 trees) in Michigan, according to census reports.

	Not of Bearing Age		Bearing Age	
	1930	1920	1930	1920
Apples	1,394	2,050	5,200	5,616
Peaches	1,173	2,008	2,010	3,229
Pears	149	303	829	1,249
Plums and prunes	83	143	313	377
Cherries	995+	352	1,187+	1,077
Grapes	880+	607	16,919+	11,098

Table 3.—Peach trees (in units of 1,000 trees) in selected states, according to census reports.

	Not of Bearing Age		Bearing Age	
	1930	1920	1930	1920
Group I.				
New York	786	659	1684	3038
Colorado	335	32	454	447
Utah	206	29	491	554
Washington	227	50	532	649
Total	1,554	770	3,161	4,688
Group II.				
Georgia	1,306	3,392	7,914	8,655
Illinois	1,037	840	2,990	1,011
Ohio	1,462	970	2,356	2,924
Indiana	605	568	1,325	860
Total	4,410	5,770	14,585	13,450
Group III.				
California	1,634	1,367	10,222	9,058

Assuming good yields in competing states, Michigan's position has not been improved by the passing of a decade. It is, however, of some little significance that the competing plantings were in regions of uncertain crops to a far greater degree in 1930 than in 1920. Consequently the chance of Michigan profiting by misfortunes of rival states seems somewhat greater now than it did a few years earlier. In other words, crop certainty is of greater value now than formerly. Orchards which have crops only in favorable years will produce crops selling at the lower price levels. Orchards and localities which are not advantageously located for marketing in years of plenty may still secure profits from crops in occasional years of relatively high prices. This possibility seems somewhat enhanced by the present tendency toward concentration of the Michigan peach area in Berrien county.

Michigan's Opportunities

New plantings of peaches should be made with due consideration of changes in the utilization and methods of marketing Michigan peaches. California is now producing nearly all the commercially canned peaches, and the demand for fruit for home canning is relatively smaller than it was a few years ago. Michigan peaches are, therefore, being increasingly used for immediate consumption. This hand to mouth demand is longer sustained, but less capable of absorbing a high peak of production, than was that which absorbed great quantities for home canning. Specifically, to meet the present

demand with any one variety, as Elberta, is to miss the opportunity of selling earlier and later varieties and to court the risk of overloading the market at one time, with unduly low prices.

The development of truck transportation, with the usually more direct transactions it involves, permits delivery to various markets of fruit nearer the desirable tree-ripened condition than was formerly the case. The superior shipping qualities of Elberta have consequently lost something of the importance they once held. Other varieties can be delivered at consumption points in better condition and better quality than ever before. This fact enables early varieties in Michigan to compete with late ripening peaches imported from the south on increasingly better terms. Recent years have shown that varieties ripening somewhat later than Elberta sell well.

Production of a succession of varieties will, under present conditions, permit the marketing of a larger total crop than would be possible with any single variety. A few days of hot weather at the marketing season of one variety will not mean a bad year for all peaches, as it does when a single variety wholly dominates an orchard or a section. Not every variety will be profitable every year; sometimes early varieties will find the market overloaded and sometimes late varieties will be too late. However, the very factor that makes the one temporarily unprofitable is likely to make the other more profitable.

The census figures do not warrant extensive increases in total plantings, particularly for wide marketing of Elberta. There is opportunity, however, for making an acreage equal to, or even slightly greater than, the present acreage, more profitable, through better meeting changed conditions.

EFFECT OF CONDIMENTAL STOCK FOOD TONICS ON MILK PRODUCTION

GEORGE E. TAYLOR AND ERNEST L. ANTHONY, SECTION OF DAIRY HUSBANDRY

Thirty different brands of so-called stock food tonics for dairy cattle were licensed in Michigan for the year ending June 30, 1932, under the provisions of the Michigan Livestock Remedy Law. Such remedies are widely advertised in practically all farm papers and magazines and also in the local newspapers. Dairy cattle tonics and stock food tonics are sold throughout the entire State. Although there are no figures available showing the exact tonnage of stock food tonics sold in the State annually, the number of dairy cattle tonics licensed in Michigan for the year 1932 indicates to a degree the enormous amounts that are being purchased by Michigan dairymen at the present time.

As the name "tonic" indicates, these foods contain a wide variety of ingredients for the purported purpose of stimulating, invigorating or otherwise improving the health of dairy animals. Thus indirectly, they are supposed to increase milk production. Some of these preparations are advertised to cure or prevent abortion, garget, milk fever, retained afterbirth,

cowpox, and also to prevent animals from going off feed. The list of drugs and elements or their salts commonly used in stock foods include: nux vomica, tartar emetic, arsenic, capsicum, eucalyptus, Glaubers salts, Epsom salts, copperas, uva ursi, rosemary, chenopodium, cascara, senna, rosin, sograda, gentian, quassia, poke root, ginger, salt peter, asafoetida, mandrake, areca nut, colocynth pulp, foenugreek seed, anise seed, cumin seed, fennell seed, poplar bark, Peruvian bark, princess pine, blood root, sodium bicarbonate, sodium nitrate, sodium sulphate, sodium hyposulphite, copper sulphate, calcium carbonate, calcium phosphate, potassium nitrate, and potassium iodide. Other ingredients are used expressly as fillers such as, sodium chloride (common salt), flax seed meal, wheat bran, alfalfa meal, palmo meal, peanut hulls, charcoal, sulphur, and wood ashes.

Stock food tonics are not advertised by the manufacturer as feeds, nor are they advocated to take the place of feed in the ration. Instead they are recommended to be a general conditioner, tonic, appetizer, laxative, diuretic, or mineral supplement. The various claims made for stock food tonics by the manufacturer naturally vary considerably, according to the intelligence and honesty of the manufacturer. One of the leading stock food tonics sold in Michigan is advertised to increase feed consumption and thus influence milk production to a degree that the milk production of seventeen cows fed tonic equals the production of 23 cows not fed tonic. Cost of production figures published by the manufacturer shows that the production cost per 100 pounds of milk can be lowered from $1.09 per hundred to $0.89 per hundred pounds by feeding tonic.

The dairyman who is desirous of knowing the exact composition and the percentaage of each active ingredient as well as the percentage of filler, included in these various mixtures may secure this information by writing the Commissioner of Agriculture, State Department, Lansing, Michigan. This information may also be found on labels affixed in a conspicuous place on each sack, box, carton or container in which such stock food tonic is sold. However, information regarding the actual feeding value of such conditioners, from a practical standpoint, has not been available. In order to have such authentic information available, an experiment was conducted at the Michigan Agricultural Experiment Station during the year 1930. The experiment was planned to demonstrate the value of stock food tonics when fed as a supplement to a balanced dairy ration.

Ten purebred dairy cows were selected from the College herd and divided into two groups of five cows each. The animals in each group were paired as equally as possible from the standpoint of period of lactation, previous production of milk, butterfat, and percentage of butterfat, consistency of production, size, breed, and gestation period.

The basal ration fed to both groups consisted of alfalfa hay, and corn silage as a roughage supplemented with the following grain ration:

Ground corn	300 pounds
Ground barley	300 pounds
Ground oats	400 pounds
Cottonseed meal (43 per cent)..	100 pounds
Linseed oil meal	100 pounds

One of the leading stock food tonics sold in Michigan was selected and purchased from a local feed store. According to the statement of the manufacturer this tonic contained nux vomica, quassia, iron sulphate, iron oxide,

sodium sulphate, sodium chloride (salt), sodium nitrate, calcium carbonate (ground limestone), calcium phosphate (bone black), potassium iodide, fenugreek, and charcoal. This tonic was fed exactly according to the directions and recommendations of the manufacturer. For the first week that each animal was fed stock food, approximately 42 grams (1½ ounces) of tonic was mixed daily with the grain ration at time of feeding. The amount of tonic fed at each feeding was measured in a measure furnished by the manufacturer. Beginning with the second week, the amount of tonic fed daily was increased to 84 grams (3 ounces) mixed with the grain ration and fed twice daily.

Daily milk weights were kept and the percentage of butterfat in the milk was determined by a regular official one-day test taken every thirty days. Animals in group I were fed tonic for the first 90 days of the experiment. Animals in group II were not fed tonic during the same period. At the end of the first 90 days, the tonic was removed from the ration of group I and added to the ration of group II. The experiment was then continued for a second 90-day period.

The animals were weighed for three consecutive days before each 30-day feeding period and at the close of the last period. The animals were housed in the main dairy barn and were allowed daily exercise in a dry lot. Wheat straw was used for bedding. The cows had free access to water from individual drinking cups. All grain, hay, and silage fed were weighed and the

Table 1.—Showing milk and fat production during each 90-day period on tonic and no tonic rations.

Animal No.	No Tonic		Tonic		No Tonic		Total Production 180 Day Period	
	Milk lbs.	Fat lbs.	Milk lbs.	Fat lbs.	Milk lbs.	Fat lbs.	Milk lbs.	Fat lbs.
Group I.								
230	....	....	4198.0	145.64	3528.4	126.95	7726.4	272.59
253	..	.....	3702.8	119.15	2588.5	86.21	6291.3	205.36
9	.....	....	3320.5	153.39	2852.4	126.67	6172.9	280.06
122	...	.....	4177.4	163.31	2963.7	110.50	7141.1	273.81
123	....	......	2209.0	82.51	1751.1	59.67	3960.1	142.18
Group II.								
218	2384.4	84.64	882.5	28.84	.....	......	3266.9	113.48
199	3465.2	105.12	2265.6	72.97	......	......	5730.8	178.09
4	2952.7	144.00	2594.2	119.59	....	......	5546.9	263.59
126	3724.7	144.82	3112.5	112.81	......	....	6837.2	257.63
66	1682.9	82.29	1433.2	68.43	....	....	3116.1	150.72
Total	14,209.9	560.87	27,895.7	1066.64	13,684.1	510.0	....	....

	Tonic Ration lbs.	No Tonic Ration lbs.	Difference lbs.
Total Milk Production	27,895.7	27,894.0	1.7
Total Fat Production	1,066.64	1,070.87	4.23

daily amounts for each animal were recorded. Special mangers were used to avoid waste and facilitate feeding. Daily health notes and observations were recorded by the herdsman.

A summary of the milk and butterfat production for both group I and group II is given in Table 1.

A study of the summary in Table 1 reveals the fact that the cows receiving the no tonic ration produced 1.7 pounds less of milk and 4.23 pounds more of butterfat.

A summary of the milk and butterfat production of each group corrected on the basis of 4 per cent milk is shown in Table 2.

Table 2.—Showing milk production during each 90-day period on tonic and no tonic rations—4 per cent fat corrected milk. (Milk lbs. x .4 plus butterfat x 15.)*

Animal No.	No Tonic	Tonic	No Tonic	Total Production
	4 Per cent Fat Corrected Milk lbs	4 Per cent Fat Corrected Milk lbs.	4 Per cent Fat Corrected Milk lbs	4 Per cent Fat Corrected Milk lbs.
Group I.				
230		3,863 80	3,315 61	7,179.41
253	. . .	3,268 37	2,328 55	5,596 92
9		3,629 05	3,041 01	6,670 06
122		4,120 61	2,842 98	6,963 59
123		2,121 25	1,595 49	3,716 64
Group II.				
218	2,223 36	785 60		3,008 96
199	2,962 88	2,000 79		4,963 67
4	3,341 08	2,831 53		6,172 61
126	3,662 18	2,937 15		6,599 33
66	1,907 51	1,599 73		3,507 24
Total	14,097 01	27,157 88	13,123 64	. . . .

	Tonic Ration lbs	No Tonic Ration lbs.	Difference lbs.
Total Production 4 Per cent Milk	27,157 88	27,220.65	62 77

The results of milk production on the basis of a 4 per cent fat corrected milk shows that the animals not fed tonic produced 62.77 pounds more milk than animals fed stock food tonic. This slight total difference in production on the two rations may easily be accounted for within the limits of experimental error.

Throughout the experiment various cows were slow in cleaning up their grain ration when tonic was mixed with it. During the tonic feeding period, animal 9 was thrown off feed five times; animal 122 three times; animal 4 six times. Animals 9 and 4 bloated repeatedly during the tonic feeding period.

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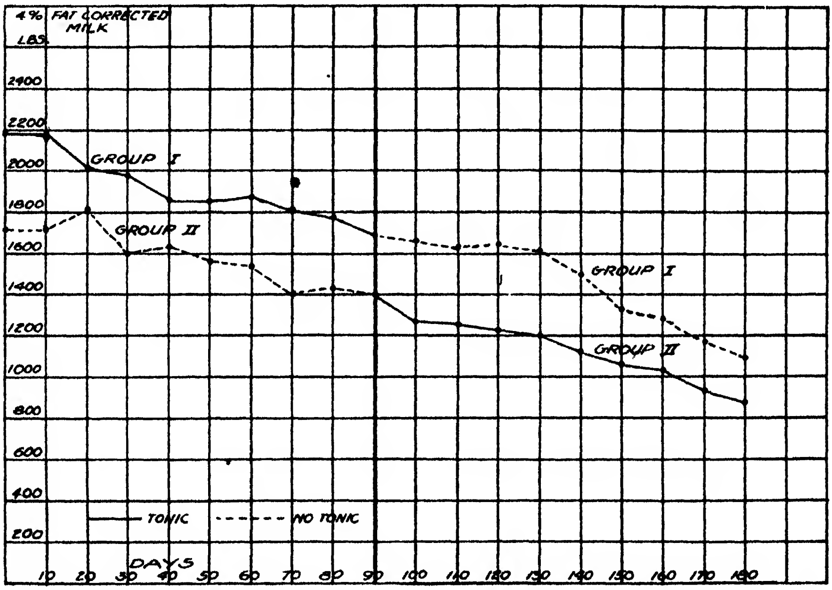
*Illinois Exp. Sta. Bul. No. 245.

Tonic was also added to the rations of four other cows in the herd not on experiment. The results with these four cows further indicated that tonic was not palatable or relished by dairy animals. It was often necessary to mix part of the tonic ration with silage in order to induce the animals to clean up the grain fed.

Graph I shows the production of four per cent fat corrected milk for groups I and II for each 10-day period. Due largely to the lowered production of animal 218, the milk production of group I remained somewhat higher throughout the experiment than the production of group II.

Graph I.—Showing production of 4 per cent fat corrected milk on tonic and no tonic rations.



Although the experiment did not show any appreciable difference in production between the tonic and no tonic rations it was deemed advisable to conduct a second experiment during 1931 as a further check on the 1930 work.

The plan of the second experiment conducted during 1931 was the same as the first, with the exception that beet pulp was substituted for silage in the basal ration. The double reversal method was also used and the rations for both group I and group II were switched at the end of each 60-day period. The experiment was continued for three 60-day periods or a total of six months. The method of procedure, management and care of animals were not changed.

Information regarding each animal used on the experiment is summarized in Table 3.

The butterfat production for groups I and II is summarized in Table 4 and the milk production in Table 5.

Animals on the tonic ration produced 10.68 more pounds of butterfat and 383.8 less pounds of milk than did the animals on the no tonic ration.

Table 3.—Showing information regarding animals used on experiment.

Animal No.	Breed	Age years	Weight lbs.	Days in Milk at Beginning of Experiment	Days in Pregnancy During Experiment	Daily Milk Yield at Beginning of Experiment	Per cent Butterfat in Milk at Beginning of Experiment
Group I.							
70.....	Pb Jersey.. . .	6	1,010	82	180	22	5 4
188... .	Pb Holstein ..	6	1,417	126	180	52	3 3
230.....	Pb Holstein . .	5	1,228	70	138	60	3 2
266.....	Pb Holstein	3	1,226	20	127	55	3 5
267.....	Pb Holstein	2	1,309	76	167	50	2.9
Group II.							
72 .	Pb Jersey....	4	920	142	180	22	5 6
169...	Pb Holstein ..	6	1,541	81	177	60	3 6
199 . .	Pb Holstein . .	6	1,385	60	178	57	3 3
253.....	Pb Holstein . .	4	1,474	51	98	46	3 6
275 ..	Pb Holstein .	2	1,235	89	180	60	3 0

Expressing the milk and butterfat production in terms of 4 per cent fat corrected milk, the animals fed on tonic ration produced 6.68 more pounds of milk than did the animals on the no tonic ration as shown in Table 6.

Graph II shows the production of 4 per cent milk for both groups I and II by 10-day periods. Note that the production during the first 60-day period was practically the same for both groups. The production of group

Graph II.—Showing production of 4 per cent fat corrected milk on tonic and no tonic rations.

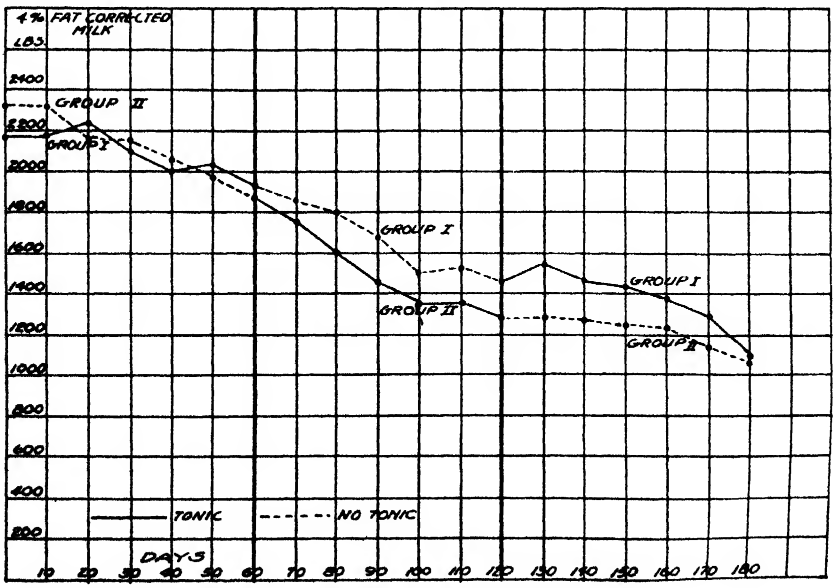


Table 4.—Showing butterfat production during each 60-day period on tonic and no tonic rations.

Group I.

Period	Cow 70	Cow 188	Cow 230	Cow 266	Cow 267	Total
	lbs.	lbs.	lbs.	lbs.	lbs	lbs.
I. Tonic Ration. . . .	67 69	102 82	102 80	117.14	83 71	474 16
II. No Tonic Ration . . .	52 81	81 28	87 75	70 80	71 82	364 46
III. Tonic Ration...	37 99	72 15	89 02	64 13	56 48	319 77

Group II.

Period	Cow 72	Cow 169	Cow 199	Cow 253	Cow 275	Total
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs
I. No Tonic Ration	67 08	118 46	98 08	87 77	108 47	479 86
II Tonic Ration	15 56	78 56	78 61	60 17	90 79	323 69
III. No Tonic Ration	0 00	67 84	74 63	49 50	70.65	262 62

	Tonic Ration lbs.	No Tonic Ration lbs.	Difference lbs.
Total Butterfat Production	1,117 62	1,106 94	10 68

II dropped below the level of production for group 1 when tonic was added to the ration of the second group. Beginning with the third 60-day period, the rations for both groups were again switched so that group I received tonic and group II no tonic. Note also that the production for the two groups was practically identical again at the close of the feeding trial.

Table 5.—Showing milk production during each 60-day period on tonic and no tonic rations.

Group I.

Period	Cow 70	Cow 188	Cow 230	Cow 266	Cow 267	Total
	lbs.	lbs	lbs.	lbs.	lbs.	lbs.
I. Tonic Ration..........	1,186 3	3,033 4	3,383.4	3,036 6	2,826 7	13,466 4
II. No Tonic Ration	884 9	2,524 1	2,823 4	2,322 3	2,278 2	10,832.9
III. Tonic Ration..........	586 9	1,888 9	2,392 1	1,767.8	1,868.2	8,503 9

Group II.

Period	Ccw 72	Cow 169	Cow 199	Cow 253	Cow 275	Total
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
I. No Tonic Ration	1,136 4	3,188 2	3,196 5	2,484.9	3,413.8	13,419.8
II. Tonic Ration.	261 2	2,103 9	2,684.8	1,968 9	3,038 8	10,057.6
III. No Tonic Ration	00 0	1,914.6	2,125 2	1,717 6	2,401.6	8,159.0

	Tonic Ration lbs.	No Tonic Ration lbs.	Difference lbs.
Total Milk Production....................	32,027 9	32,411.7	383.8

Table 6.—Showing milk production during each 60-day period on tonic and no tonic rations—4 per cent fat corrected milk. (Milk lbs. x 4 per cent plus fat lbs. x 15.)

Cow No.	Tonic Period	No Tonic Period	Tonic Period	No Tonic Period	Total per Cow
Group I.					
	lbs	lbs	lbs	lbs.	lbs
70	1,489 87	1,146 11	804 61	.....	3,440 59
188	2,755 66	2,228 84	1,837 81	...	6,822 31
230	2,895 36	2,415 61	2,292 14	.....	7,633.11
266	2,971 74	1,990 92	1,669 07	.....	6,631 73
267	2,386 33	1,988 58	1,594 48	.....	5,969 39
Group II.					
72	.....	1,460 76	337 88	—	1,798.64
169	...	3,052 18	2,019 96	1,783 44	6,855 58
199	......	2,749 80	2,253 07	1,969 53	6,972 40
253	..	2,310 51	1,690 11	1,429 54	5,430 16
275	....	2,992 57	2,577 37	2,020 39	7,590 33
Total	12,498 96	22,365 88	17,076 50	7,202 90	....
Average per Cow	2,499 79	2,236.58	1,707 65	1,440 58	.....

	Tonic Ration lbs.	No Tonic Ration lbs	Difference lbs.
Total Production 4 Per cent Milk	29,575 46	29,568 78	6 68

The cost of tonic fed per cow per day was approximately two cents, making a total cost of $10.80 for the tonic fed during 180-day feeding trial. The results expressed on the basis of 4 per cent fat corrected milk show that cows fed tonic produced only 6.68 pounds more milk for the group than animals on the no tonic ration. This very slight difference in production is too small to be of any significance. This very slight increase in milk production was produced at an added cost of approximately $180.00 per 100 pounds of 4 per cent milk.

Daily observations again revealed the fact that the particular stock food tonic fed during the feeding trials is not palatable, nor does it add to the palatability of the entire ration fed. Various animals repeatedly refused either all or a portion of their grain ration when tonic was mixed with it. In many instances it was necessary to cover the grain with wet beet pulp in order to get the cows to clean up their grain ration. Animal 188 became bloated and went off feed once during the tonic feeding period. Animal 169 was similarly affected four different times. Animal 72 was thrown entirely off feed as a result of adding tonic to her ration. Even when the daily tonic allowance was temporarily discontinued or was reduced by one-half, this cow continued to be off feed, dropped in production, and went entirely dry during the tonic feeding period.

Attention is called to the fact that only one brand of stock food tonic was fed during the two experimental feeding trials. This particular brand was chosen because it is one of the leading stock food tonics for dairy cattle sold

in Michigan. It was also fairly representative as regards composition and ingredients included or used in the mixture, when compared with other stock food tonic mixtures sold in the state. The results of this experiment certainly indicate that in the absence of absolutely reliable, impartially obtained, definite experimental data supporting the supposed beneficial effects of such tonics, farmers are not warranted in spending money for them.

The animals were weighed for three consecutive days at the beginning of each 30-day feeding period and again at the end of the last period. These data are summarized in Table 7. Note that the cows gained 111 more pounds in body weight on the no tonic ration compared to the similar gain in weight on the tonic ration.

Table 7.—Showing weights of animals by 30-day periods.

Group I.

Cow No.	Initial weight	Weight at end of 1st and 2nd 30-day periods		Weight at end of 3rd and 4th 30-day periods		Weight at end of 5th and 6th 30-day periods		Tonic		No Tonic	
		Tonic		No Tonic		Tonic		Gain	Loss	Gain	Loss
	lbs.	lbs.	lbs.	lbs.	lbs	lbs	lbs.	lbs.	lbs.	lbs.	lbs.
70	1,010	1,058	1,064	1,073	1,058	1,099	1,069	54 11 40	.....	...	6
188	1,417	1,435	1,457	1,502	1,471	1,546	1,549	78	.	14	
230	1,228	1,205	1,216	1,219	1,234	1,257	1,252	18	12	18	
266	1,226	1,171	1,208	1,200	1,232	1,277	1,277	45 42	18	24	
267	1,309	1,318	1,351	1,361	1,406	1,436	1,438	32	...	55	

Group II.

Cow No.	Initial weight	No Tonic		Tonic		No Tonic		Tonic		No Tonic	
								Gain	Loss	Gain	Loss
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
72	920	929	975	998	1,018	1,071	1,079	43	....	55 61	
169	1,541	1,513	1,536	1,567	1,566	1,585	1,593	30	......	27 37	5
199	1,385	1,416	1,422	1,445	1,406	1,450	1,415	....	18	9 29	
253	1,474	1,503	1,503	1,548	1,539	1,571	1,569	36	......	30 60	
275	1,235	1,249	1,295	1,302	1,316	1,386	1,423	21	......	105	
Total	....	......	....	....	.....	......	......	450	48	524	11

	Tonic Ration lbs.	No Tonic Ration lbs.	Difference lbs.
Total Gain in Body Weight	402.0	513.0	111.0

Although stock food tonics are advertised and advocated as appetizers, the cows actually consumed less roughage and also less grain during the tonic feeding period. Feed consumption data are shown in Table 8.

Table 8.—Showing feed consumption during each 60-day period.

Group I.

Cow No.	Period 1—Tonic			Period 2 -No Tonic			Period 3 -Tonic		
	Hay	Beet Pulp	Grain	Hay	Beet Pulp	Grain	Hay	Beet Pulp	Grain
	lbs.	lbs.	lbs	lbs.	lbs	lbs.	lbs.	lbs.	lbs
70	726	360	429 3	726	360	318 0	726	360	240 0
188	1,056	360	900 0	1,056	360	793 4	1,056	360	593 4
230	1,056	360	999 0	1,056	360	826 5	1,056	360	708 0
266	972	360	886 5	972	360	697 5	972	360	528 0
267	1,002	360	837 0	1,002	360	682 5	1,002	360	559.5

Group II.

	Period 1--No Tonic			Period 2—Tonic			Period 3—No Tonic		
	lbs	lbs.	lbs.	lbs	lbs	lbs	lbs.	lbs.	lbs.
72	792	360	418 5	792	351	193 8	792	360	28 0
169	1,050	360	963 0	1,050	346	643 6	1,050	360	540.0
199	1,044	360	938 7	1,044	360	804 9	1,044	360	645 0
253	1,050	360	677 5	1,050	360	578 2	1,050	360	501 9
275	1,014	360	1,035 3	1,014	360	890 1	1,014	360	746 4

Tonic Ration Feed Consumption in Pounds		No Tonic Ration Feed Consumption in Pounds		Difference
Hay	14,574 0	Hay	14,712 0	138 0
Beet Pulp	5,377 0	Beet Pulp	5,400 0	23 0
Grain	9,791 3	Grain	9,812 2	20 9

Summary and Conclusions

1. The feeding of stock food tonic did not influence milk production.
2. The cost of milk production was increased by feeding tonic.
3. Stock food tonic was not palatable when fed to dairy animals.
4. The feeding of stock food tonic, according to recommendations advocated by the manufacturer, caused animals to go off feed and produced bloating in several cases.
5. Animals fed tonic showed no signs of improved health or general vigor. Animals also gained more in body weight on the no tonic ration.
6. The feed consumption was slightly lowered by feeding tonic.
7. The feeding of stock food tonic is not warranted or recommended as a supplement to a properly balanced dairy ration for milking cows.

BULLETIN REVIEWS

Circular Bulletin 144.—"Flies and Mosquitoes Commonly Found About Michigan Homes."—McDaniel, E. I.—Circular Bulletin 144 deals with flies and mosquitoes common about Michigan dwellings. A number of the common species are discussed from the standpoint of habits, life-history and importance. Special stress is placed on control by sanitary measures, as well as by artificial means. The bulletin is intended to acquaint the people of Michigan with such species as are particularly dangerous to human health. The chapter on mosquitoes terminates with a tabulated habit-sketch of a number of species of mosquitoes recorded from this region.

This bulletin replaces Circular Bulletin 106, "Flies Common About Michigan Dwellings." (27 pages, 4 figures, 1 table.)

Circular Bulletin 146.—"Three Virus Diseases of the Peach in Michigan."—Cation, D.—The symptoms of Peach Yellows and Little Peach are compared with the more recent disease known as Red Suture. The developments as they appeared in artificially inoculated trees in the college orchard are recorded. Control consists of maintaining the normal vigor so that the symptoms may be readily recognized and the affected trees promptly removed. (11 pages, 2 figures.)

Special Bulletin 226.—"Activities of Churches in Town-Country Communities."—Hoffer, C. R.—An intensive analysis of the data pertaining to meetings sponsored by 47 churches and their auxiliary organizations in 10 town-country communities shows that churches are an important means of providing opportunity for social contacts among rural people. During the period of one year these 47 churches held 3,777 regular church services with a total accumulated attendance of 388,484. Two thousand and fifty-one meetings of Sunday Schools were held and regular meetings of auxiliary organizations totaled 1,368. In addition to these regular meetings 45 special meetings were scheduled. A considerable proportion of these were attended by the various age and sex groups residing in the communities, even though they were not members of a church or its auxiliary organizations.

Programs of regular meetings like church services and Sunday Schools were relatively well standardized, although occasionally additional features permitting participation of local residents in some special way were added. At special meetings programs were more varied and were dependent upon the interests of the group sponsoring them. Many of these provided opportunity for active participation of individuals separately or in groups and thus were especially important as a means of socialization. Country residents participated in all of these activities but neither their attendance nor participation were in proportion to the percentage of country population in the various communities. (27 pages, 4 tables.)

Technical Bulletin No. 124.—"The Various Effects of Frost Protectors on Tomato Plants."—Hibbard, R. P.—Various kinds of cover materials were used over a period of six years under a variety of climatic conditions to determine which would produce the least deleterious effects upon the physiology of the plants. Frost protectors cannot be unreservedly recommended nor unreservedly condemned. They were of undoubted value in one year (1925) out of six; of doubtful value in two (1926 and 1928), and of no value in three (1927, 1930, 1931). Under glassine and glassine-like covers plants more frequently matured fruit earlier, yielded more heavily when prices were high, and lost less fruit by frost at the end of the season than under any other type of cover. The protective effect of the various covers was due far less to checking radiation losses than to providing a higher maximum on the previous day from which the descent began. (35 pages, 5 figures, 3 plates, 8 tables.)

Technical Bulletin No. 127.—"On the Control of Caecal Coccidiosis in Chickens."—Chandler, W. L.—Caecal coccidiosis is a very common disease of chicks. The seat of the infection is the lining of the caeca or blind sacs of the lower intestine. The organism causing the disease is a microscopic animal parasite which is capable of multiplying in the intestinal wall to the extent that often the lining of the intestinal wall is almost completely destroyed. During the course of the infection a tremendous number of microscopic egg-shaped cysts (oocysts) are produced. These pass from the chick with the droppings and after a short period of incubation in the litter and on the floor of the brooder house are capable of infecting other chicks. The symptoms of a severe infection are bloody droppings, ruffled feathers, drooping wings, loss of appetite, and pale combs.

Caecal coccidiosis usually starts in a flock of chicks by one or more of the birds becoming mildly infected through having eaten oocysts which have in some manner or other gotten on to their feed, or into the drinking water, or on some object which they have pecked. The oocysts passed from these mildly infected birds, infect others and eventually large numbers of oocysts are eaten by individual birds and severe infections result. When the symptoms are sufficiently pronounced in the case of one or more birds in a flock as to be recognized as those of coccidiosis, the disease will probably be firmly established in the flock and measures for its control should be directed against the entire flock rather than sick individuals.

With the first appearance of symptoms of caecal coccidiosis the chicks should be placed on a diet consisting of 40 per cent dried milk, preferably dried skim milk, for two or three days and then the amount of dried milk reduced to 15 per cent, which amount may be fed for a month or so. The iodine content of the feed should also be increased slightly above that normally required. All litter should be removed from the brooder house and either burned or buried. The floors and utensils should be thoroughly cleaned and scrubbed with a lye solution, rinsed with water, and disinfected. Colloidal Iodine (Chandler) appears to be the only material which will kill the oocysts on the floors of brooder houses. Iodine Suspensoid Merck is Colloidal Iodine (Chandler) containing 20 per cent Iodine. One pound of this suspen-

soid diluted with water to make 12 gallons gives a practical disinfectant strength for use on clean floors. If lye has been used in the cleaning process, one pound of commercial hydrochloric acid should be added to the 12 gallons of diluted suspensoid. In severe cases the cleaning and disinfecting should be repeated in about four days. (24 pages, 4 figures, 4 tables.)

NOTE.—Some recent observations at this station indicate that, though even strong solutions of hypochlorites will not kill coccidial oöcysts, strongly acidulated hypochlorites solutions will kill coccidial oöcysts and bacteria embedded in small particles of fecal matter when small amounts of these materials are shaken for 10 minutes in a test tube with the freshly acidulated hypochlorites. Free chlorine appears to be the active lethal agent and since free chlorine is very volatile and highly corrosive, some safe, practical method for the application of effective strengths and volumes of strongly acidulated hypochlorites in poultry house disinfection must be worked out before any specific recommendations can be made regarding this. For the present at least the application of colloidal iodine appears to be the only safe practical means of disinfecting poultry house floors and equipment.

JOURNAL ARTICLE ABSTRACTS

"Inheritance of White Sheath in Maize."—Clark, F. H.—Jour. Heredity. 23 (6): 235-237. 1932.—(Journal Article No. 68 (n. s.) from the Michigan Agricultural Experiment Station.)—Inheritance studies made with white sheath, a chlorophyll abnormality of maize that appeared in a corn breeding plot at the East Lansing station, show that white sheath depends for its expression on the presence of two complementary unlinked recessive factors. Linkage data suggest a loose linkage with shrunken endosperm.

"A Clinical Study of Forty Cases of Disease of the Reproductive Organs of the Cow."—Meyer, D. B.—Jour. Am. Vet. Med. Assoc. (N. S. 34): (1): 62-70. 1932.—(Journal Article No. 71 (n. s.) from the Michigan Agricultural Experiment Station.)—The pathological condition or conditions of the reproductive organs treated in each of the 40 cows included in this study varied from a very slight catarrhal inflammation to a severe, chronic pyometra. In many cases more than one abnormal condition existed at one time or one followed the other.

Nine cases of catarrhal (chronic or acute) metritis were treated by irrigating the uterus with 2 or 4 per cent Lugols solution or with 0.85 per cent salt solution during an estrual period and bred immediately. All cases receiving the Lugols solution treatment conceived within 60 days after treatment. Three of those douched with the physiological salt solution conceived within 22 days, one not until nine months, and two were slaughtered several months following treatment without conceiving.

Twelve animals were treated for retention of fetal membranes by one or more injections of mineral oil and iodoform and removal of membranes within eight days. Only three conceived normally while the remainder required further treatment of conditions which developed as a sequel to the retention and three of them never did conceive, one being slaughtered without having been bred.

Pyometra in seven cases was treated by one or more irrigation with Lugols solution. Five of the cases eventually conceived and one was slaughtered after two services and failed to come in heat.

Of the seventeen cases treated for various pathological conditions of the ovaries only three failed to conceive and all but one of those which conceived did so after one service only.

"A Study of Two Septoria Leaf Spots of Celery."—Cochran, L. C.—Phytopathology. 22 (10): 791-813. 1932.—(Journal Article No. 84 (n. s.) from the Michigan Agricultural Experiment Station.)—Two distinct species of Septoria were isolated from characteristic lesions on celery leaves and proved to be the cause of two forms of late blight. The species responsible for most of the damage to celery in Michigan produces a small indefinite leaf lesion, characterized by closely crowded black fruiting bodies both in the center of the spot and in the border-

ing green leaf tissue. This fungus was found to flourish during the fall when moisture is plentiful and the temperature is between 60° and 65° F. The other species, more common in Europe, produces a larger spot surrounded by a reddish brown border, with small fruiting bodies found only in the central portion. The large spot producing Septoria was found only on leaves and was most abundant on summer celery.

"The Strawberry Root-Weevil, Brachyrhinus (Otiorhynchus) Ovatus as a Conifer Pest."—McDaniel, E. I.—Jour. Econ. Entom. 24 (4): 841-843. 1932.—(Journal Article 88 (n. s.) from the Michigan Agricultural Experiment Station.)—Apparently there has developed a distinct race of the strawberry root-weevil, *Brachyrhinus ovatus,* the larvae of which feed only on the root systems of two-and three-year old conifer seedlings growing in seed beds. The infestation has built up among growing conifers for a quarter of a century or more in a comparatively restricted area. The larvae in the soil can be killed by the use of carbon disulphide emulsion used at the same strength recommended for the control of the Japanese beetle. The adults can be killed by the use of poisoned bran bait, made according to the same formula recommended for the control of cutworms, except that oil of apples in place of amyl acetate should be used as an attractant. When the three-year-old seedlings are removed from the seed-beds in the early spring and transplanted to clean soil, the loss will be reduced.

The Bulletins of this Station are sent free when available to such individuals as may request them. Address all applications to the Director, Agricultural Experiment Station, East Lansing, Michigan.

LIST OF AVAILABLE BULLETINS

Regular Bulletins—

262 Suggestions on Planting Orchards.
264 Second Report of Grade Dairy Herd.
277 Studies in the Cost of Market Milk Production.
281 Beautifying Farm Home Grounds.
284 Some Information and Suggestions Concerning the Use of Phosphorus.
286 Studies and Cost of Milk Production—No. 2.

Special Bulletins—

71 Studies in the Range and Variation of the Per Cent of Butter Fat in the Milk of Individual Cows.
83 Key to Orthoptera of Michigan.
91 Lime for Michigan Soils.
94 The Financial History of a Twelve-Year-Old Peach Orchard
98 Vinegar.
100 Soy Beans.
101 Oats in Michigan.
106 Sugar Beet Growing in Michigan.
109 Crop Varieties for Michigan.
110 Special Report of the Upper Peninsula Experiment Station.
111 Studies in City Milk Distribution.
120 The Microscopic Identification and Determination of the Specific Ingredients in Stock Feeds.
124 The Colorimetric Hydrogen-ion Determination as a Means of Locating Faulty Methods at City Milk Plants.
125 Michigan Potato Diseases.
126 An Analysis of the Peach Variety Question in Michigan.
127 Nitrogen-Carrying Fertilizer and the Bearing Habits of Mature Apple Trees.
128 Sandy Soils of Southern Peninsula of Michigan.
130 The Clovers and Clover Seed Production in Michigan.
131 Tomato Growing in Michigan.
133 Fertilizers, What They Are and How to Use Them.
135 Seasonal Management for Commercial Apiaries.
138 Rural Highways.
139 Tourist Camps.
141 Profitable Pruning of the Concord Grape.
142 Grafting in the Apple Orchard.
143 Winter Pruning the Black Raspberry.
144 Spraying Dewberries for Anthracnose.
145 Christmas Tree Plantations.
149 Eighty Winters in Michigan Orchards.
150 Emergency Hay and Pasture Crops.
151 Buckwheat in Michigan.
153 Peppermint Growing in Michigan.
155 The Mint Flea Beetle.
156 Investigation With Strains of Beans.
157 Celery Culture in Michigan.
158 A Suggested Bacteriological Standard for Ice Cream.
159 Production of Ice Cream With a Low Bacterial Count.
160 Why a Cull Apple Is a Cull.
161 Varieties and Locations as Factors in Apple Production.
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165 Management Methods in the Raspberry Plantation.
166 Studies in Orchard Management with Special Reference to Cherry Production.
167 Chicory Growing in Michigan.
169 Profit and Loss in Pruning Mature Apple Trees.
170 The Detroit Milk Market.
171 Farmers' Co-operative Buying and Selling Organizations in Michigan.
172 Farm Real Estate Assessment Practices in Michigan.
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Technical bulletins, as the name implies, are devoted to reports of scientific research and designed more especially for use of other investigators, instructors and students.

The Quarterly bulletin contains contributions by all sections of the Experiment Station. It is issued during February, May, August, and November of each year. Copies are sent to the entire mailing list. The Quarterly also contains a list of available bulletins.

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All applications for bulletins should be addressed to V. R. GARDNER, DIRECTOR, East Lansing, Michigan.

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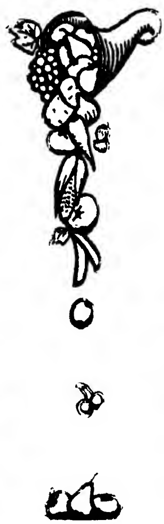
THE

QUARTERLY BULLETIN

AGRICULTURAL EXPERIMENT STATION

MICHIGAN STATE COLLEGE

Of Agriculture and Applied Science



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AGRICULTURAL EXPERIMENT STATION

MICHIGAN AGRICULTURAL EXPERIMENT STATION QUARTERLY BULLETIN
Vol. XV, No. 3, February, 1933

SELECTING SIRES BY PROGENY TO MAINTAIN BUTTERFAT LEVEL

BY A. C. BALTZER, EXTENSION DAIRYMAN

One of the main purposes of record keeping through dairy herd improvement association is to locate dairy bulls that have the ability to transmit uniformly higher milk and butterfat production to their progeny. Such dairy bulls will be found by extending the length of time of keeping the dairy bull. About 35,000 dairy bulls are kept on Michigan farms. Insufficient record information is available about these bulls but it is known that about 94 per cent of these are slaughtered before they are three years old.

Dairymen that keep records in a dairy herd improvement association are making a change in this practice of keeping bulls longer. Data show that the age of 378 bulls kept by them in 1930 was 3.77 years, whereas, in 1931, the average age of the bulls was 4.1 years. This change in practice alone will not solve this problem of improving herd sires but it is certain to bring desirable results. By keeping bulls until they are older, dairymen will increase the supply of bulls with known ability to transmit better production. Also, opportunities to trade bulls of meritorious breeding, not yet proved, will result.

Data assembled by the U. S. D. A., Bureau of Dairy Industry, are presented in Table 1, showing the likelihood of daughters of purebred bulls being better producers than their dams.

Table 1.—Shows the likelihood of daughters of purebred bulls being better producers than their dams.

Dams pounds butterfat production	Number of comparisons	Per cent bulls which made increase	Per cent bulls which made decrease	Your chance of increase
Under 200.	191	97	3	32 to 1
200 to 299.. ..	1,360	86	14	6 to 1
300 to 399..	2,497	65	35	2 to 1
400 to 499..	1,825	41	59	1 to 1½
500 to 599. .	685	22	78	1 to 3½
Over 600..	198	14	86	1 to 6

Here is an illustration of what to expect from the kind of bulls that dairymen have used in the past and are using today. The basis for selecting bulls up to this time has been: first, type, and second, records of the ancestors. This table shows that if the herd level is only 200 pounds butterfat, almost any purebred dairy bull would bring improvement, for 97 per cent

of the 191 comparisons showed an increase and only 3 per cent showed a decrease in butterfat production of the daughters compared with the dams. The chances for increased production are 32 to 1 in your favor if the herd level is only 200 pounds butterfat, which is only slightly higher than the average butterfat production of all Michigan cows.

Similarly if the herd level ranges up to 300 pounds butterfat, the chances for increased production are still very favorable with a ratio of about 6 to 1. However as the herd level advances above 400 pounds butterfat, the likelihood of a present-day purebred dairy bull bringing higher production decreases greatly for only 41 purebred bulls out of 100 raised the level of production of the daughters over the dams. Here the ratio is unfavorable,

Fig. 1.—The cow (left) at 11 years made 13,256 lbs. milk and 430 lbs. butterfat, testing 3.2 per cent. The next two cows, her two daughters by Ardale Netherland Segis, a purebred Holstein bull, made at six years, 379 lbs., test 3.3 per cent and at five years 404 lbs. butterfat, test 3.2 per cent. The next three cows, her three daughters by King Ona Segis Rosewood, another purebred Holstein bull, made at four years 389 lbs., test 3.4 per cent, at three years 451 lbs., test 3.7 per cent, and at two years 402 lbs. butterfat, test. 3.4 per cent. These are actual figures and not equivalent figures. This family of cows tested in 1930 are owned by Harry Freshour of Mason, Michigan, member in the Ingham-Mason herd improvement association.

for only one bull out of every two and one-half bulls carried the genetic ability to transmit higher butterfat production to his offspring. These data surely point out: first, that purebred bulls with the inheritance to transmit to their progeny heavy butterfat producing ability are scarce; second, that dairymen with high record herds should anticipate their sire needs and select bulls only after careful study of the progeny; and third, that more emphasis should be placed on the progeny of a purebred bull rather than on the common valuation of type and ancestry performance records.

There is need of Michigan dairymen understanding just how all this applies to their industry. Table 2 presents data taken from records made in dairy herd improvement associations and reveals the influence of 204 proved bulls. A proved bull is defined in this instance as one with five unselected daughters from five different dams. Only 19 bulls or 9.3 per cent of the 204 proved bulls were in active service when they were found to be proved. Among the 204 bulls, 96 were Holstein, 67 were Jersey and

41 were Guernsey. In the instance with the 96 Holstein bulls, the daughters averaged 12,376 pounds milk and 419 pounds butterfat with a test of 3.38 per cent. The dams of the 632 daughters averaged 11,717 pounds milk and 397 pounds butterfat with a test of 3.38 per cent. There was no increase or decrease in the butterfat test of the daughters over the dams but the daughters did produce 22 pounds more butterfat and 559 pounds more milk than the dams.

The 67 Jersey bulls show the daughters averaged 8,036 pounds milk, testing 5.41 per cent, and 435 pounds butterfat. There were 401 daughters. The dams of the daughters averaged 7,734 pounds milk, testing 5.22 per cent, and 404 pounds butterfat. This is an increase of .19 per cent in butterfat test and 31 pounds of butterfat and 302 pounds milk. The tabulation shows that the Jersey cows averaged the most pounds of butterfat among the three breeds and that the daughters of the Jersey cows also averaged the most pounds of butterfat. This does not mean however that the Jersey cows or Jersey bulls possess a higher transmitting ability for milk and butterfat production than do the other breeds because the data reported are insufficient to draw final conclusions.

The 41 Guernsey bulls produced daughters that averaged 8,298 pounds milk, testing 4.91 per cent, and 407 pounds butterfat. There were 232 daughters. The dams of the daughters averaged 7,672 pounds milk, testing 4.74 per cent and 364 pounds butterfat. This is an increase of .17 per cent in butterfat test, 43 pounds of butterfat and 626 pounds of milk. While the Guernsey daughters made most improvement in butterfat production it should be added the dams, ranked lowest in butterfat production among the three groups. However, neither of these points may be the same next year or with different individuals at another time. Here are the figures which reveal this information:

Table 2.—Shows the level of production of the dams and their daughters by 204 proved bulls of the Holstein, Jersey, and Guernsey breeds.

Breed	DAMS				DAUGHTERS				
	Av. milk	Av. test	Av. B. F.	No. of pairs	Av. milk	Av. test	Av. B. F.	Increase	
								Lbs. milk	Lbs. fat
Holstein—96 bulls.	11,717	3.38	397	632	12,376	3.38	419	559	22
Jersey—67 bulls...	7,734	5.22	404	401	8,036	5.41	435	302	31
Guernsey—41 bulls...	7,672	4.74	364	232	8,298	4.91	407	626	43
Total, all breeds—204 bulls...	9,702	4.05	393	1,295	10,229	4.1	421	527	28

This study reveals, first, that the progeny of a sire is in the last analysis the best basis for selection rather than type or ancestry performance records. It might also be said that the study reveals that the ability to transmit higher butterfat production seems to exert itself slightly stronger within the Jersey breed than by the other breeds, with the Holstein breed placing

second and the Guernsey breed placing third for this factor. Further, it should be stated that the inheritance factor varies more within the individuals of a breed rather than between the best transmitting bulls of the different breeds.

GRINDING AND ELEVATING GRAIN WITH ONE-HALF H. P. MOTOR

H. J. GALLAGHER, SECTION OF AGRICULTURAL ENGINEERING

Where electric energy is available for farm use, it is possible and highly practical to do many of the farm tasks with smaller power units and less expensive equipment than formerly were required. A good illustration of this principle is the simple home-made elevator and the small burr mill feed grinder, (Fig. 1). The elevator can be constructed at a cost for material of twenty dollars or less. The burr mill is a standard commercial product selling under eight dollars. The elevator will elevate at the rate of 200 bushels per hour; 500 bushels per kilowatt hour. The mill will grind at the rate of 200 pounds per hour; one ton per 12 kilowatt hours. A one-half h. p. electric motor is ample power for either job.

The Elevator

Figure 2 illustrates the construction details of the elevator; a single shaft (elevator leg) is used instead of the customary double shaft. Small elevator pulleys replace the ordinary large pulleys. The sides may be lumber or twenty-gauge galvanized iron. The height may be any height up to 20 feet.

Other Materials

Elevator belting, 4-in.-4-ply	$0.18 per ft.
Elevator buckets, 3½-in. x 3-in.	.14 each
Elevator bucket bolts, flat head	1.75 per 100
Three feet of 1-in. steel shafting	.17 per ft.
Twelve-inch pump jack pulley (drive pulley)..	1.00
Two 4-in. x 4-in. wood split pulleys...........	1.85 each

Details of Elevator Construction

The elevator belt should fit close to the two sides, allowing only enough clearance to avoid binding. Excessive clearance between the belt and sides permits grain to sift behind the belt and to wedge around the pulleys.

The elevator pulleys should be in line to keep the belt from creeping and should be faced with belting to decrease slippage.

The buckets should be spaced uniformly on the belt, a minimum distance of 6 inches and a maximum distance of 12 inches. The throat of the hood at Point A, Figure 2, should be below bucket B as bucket C is being emptied; otherwise, part of the grain falls down the shaft and plugs the elevator.

The grain should enter the elevator about three inches above the bottom

Y, Figure 2. Grain entering at the bottom of the elevator banks against the buckets; grain entering at points higher than three inches has no appreciable effect on the operation.

To avoid bridging, all inclines on which grain travels should be at a 30 degree or greater angle.

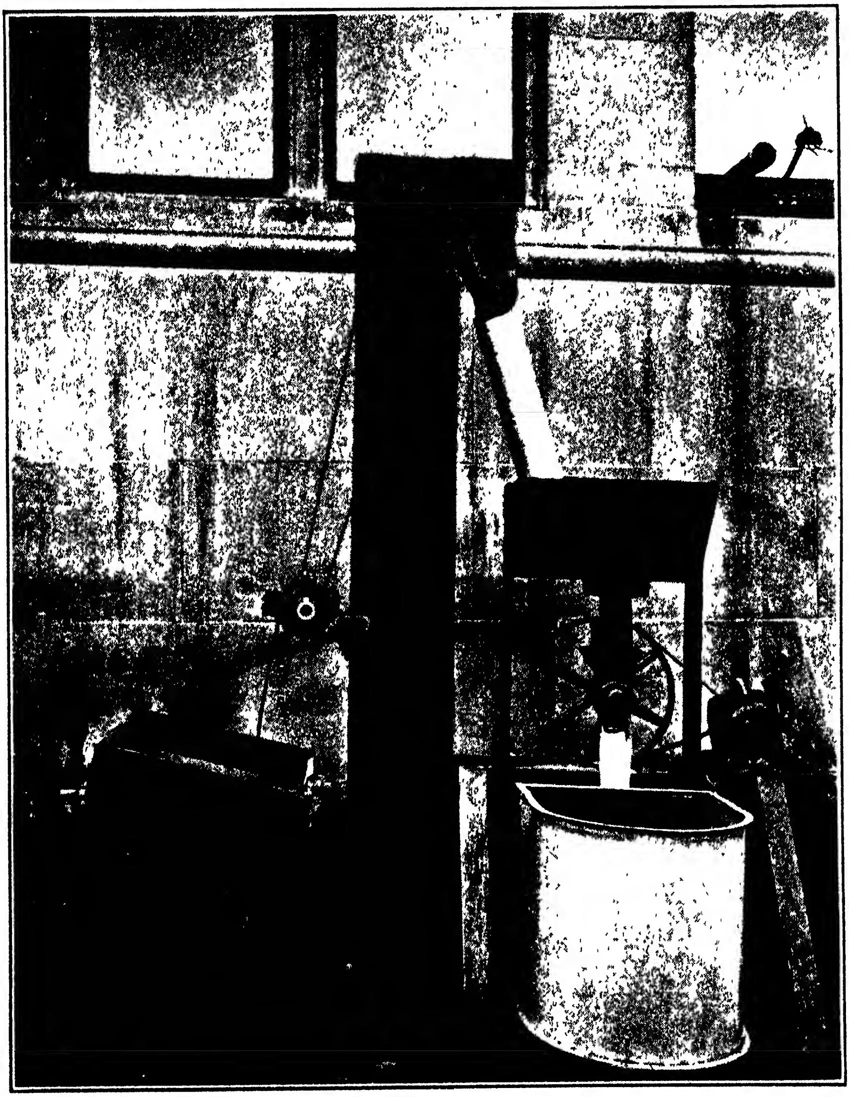
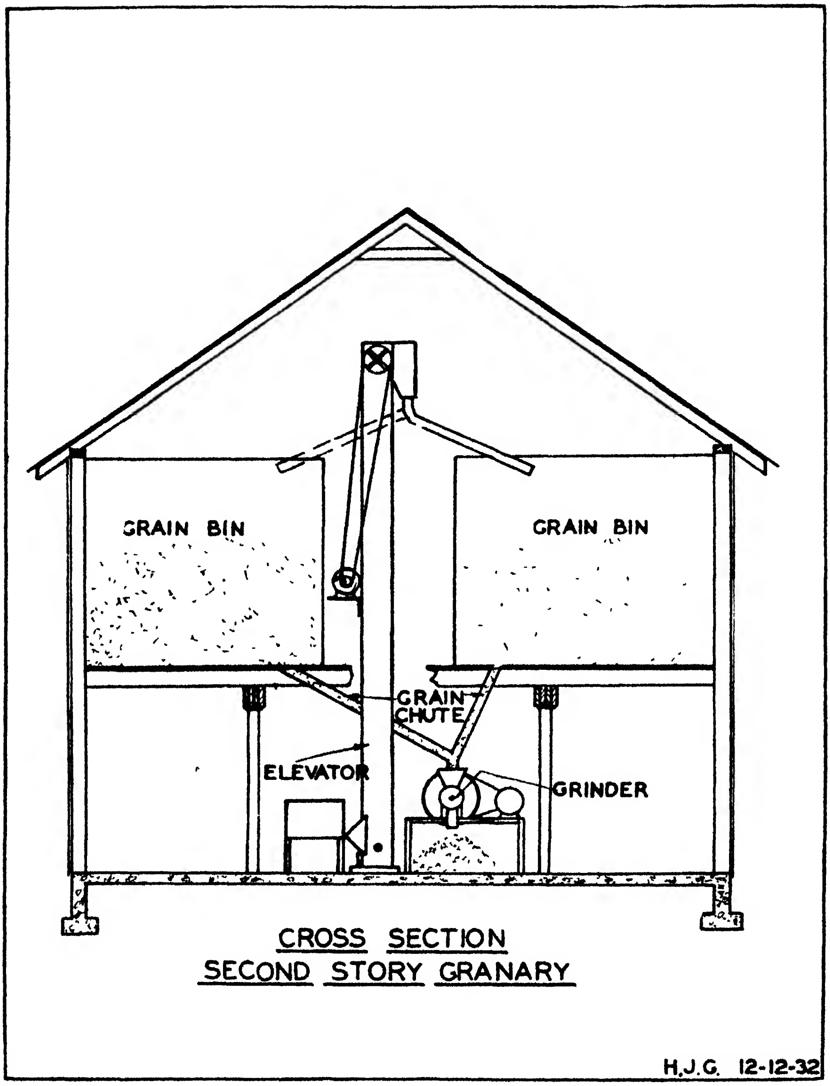


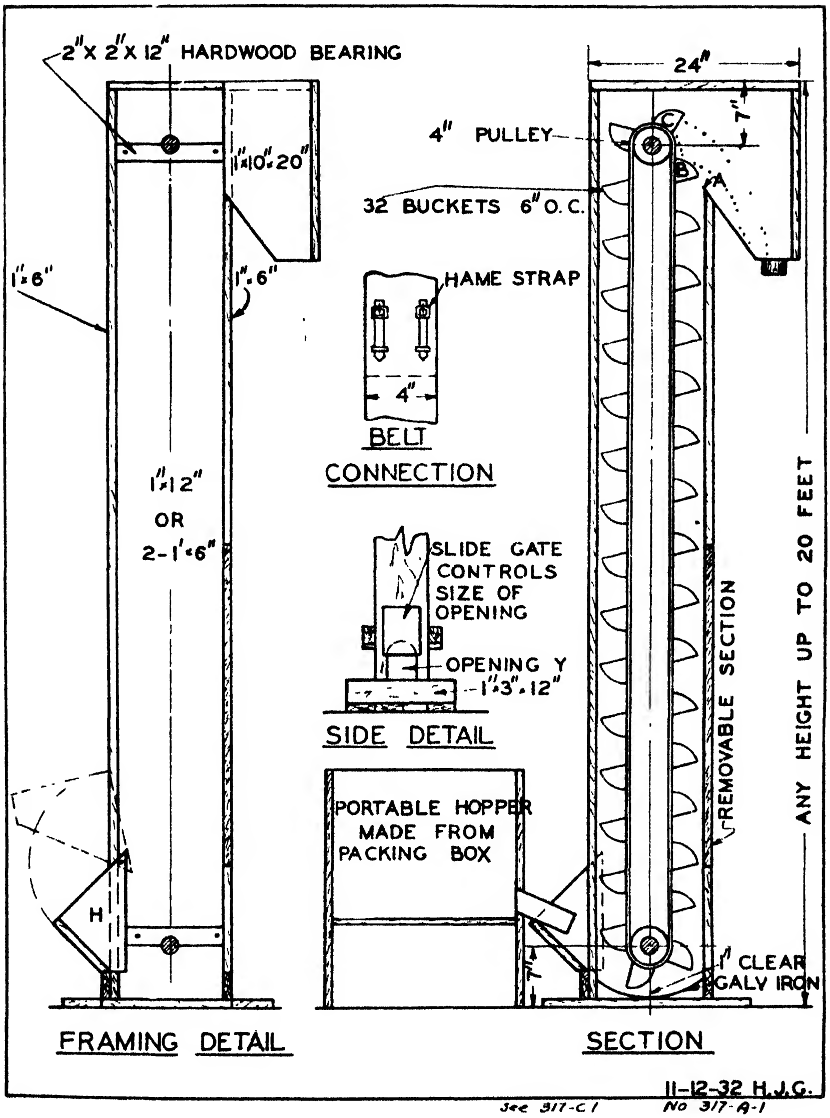
Fig. 1.—The essential feature of small grinders is that the grinding operation may be conducted without an attendant.



Recommended Speeds

	Belt speed feet per minute	Height elevator	R. P. M. elevator pulley head	Diameter motor pulley
Buckets 6 inches apart........	305.5	To 10 feet	291.7	2 inches
Buckets 12 inches apart.........	534.5	Over 10 feet	510.4	3½ inches

Capacity at above speeds in bushels per hour; oats 190, wheat 220, barley 214, corn 243.



Operation

It is desirable to mount small portable motors on a hinged base so the weight of the motor keeps the belt tight. (See Figure 1.)

A wide base or supporting legs are not needed to keep the elevators below 10 feet in height from tipping on a reasonable level floor.

The elevator hopper H., Figure 2, may be readily raised to clean the elevator if plugged.

The elevator should be emptied before the motor is stopped or started.

The grain hopper may consist of a packing box, barrel, or similar con-

tainer, since sloping bottoms or fancy designs are unnecessary. In flat bottom hoppers the grain forms its own incline and but little is left in the hopper.

The weight of an elevator 10 feet in height is below 100 pounds. They can be carried readily to new locations in filling or emptying different bins.

The power requirement is approximately one-fourth h. p.

Home Grinding

The difference in feeding value between ground and unground grain does not generally warrant high grinding costs. In the case of home grinding, the lower the cost of equipment and the lower the operating costs the greater are the profits from grinding.

The grinding assembly (Fig. 1) consists of a 4½-inch standard burr mill with 20-inch drive pulley. Mills of this type can be purchased under eight dollars. A standard one-half h. p. motor equipped with a starting and stopping protective switch and 3-in. x 3-in. fibre pulley can be purchased for $35.00 or less.

The capacity of the mill varies with the kind of grain ground and the fineness of grinding. The amount of current consumed varies from eight K. W. H. per ton (mixed grains; medium fine) to 30 K. W. H. per ton (oats fine). In Table No. 1 are the results of a number of grinding tests.

Table No. 1

Motor ½ h. p., pulley 3 inches diameter, burrs, fine Speed of mill 262 5 r. p m.

Grain	Ground	Pounds per hour	K. W. H. per 100 lbs.	K. W. H. per ton
Oats...	*Fine	40	1.5	30
	†Coarse	60	.7	14
Barley .	Fine	70	.6	12
	Coarse	145	.5	10
Wheat..	Fine	100	.6	12
	Coarse	180	.3	6
	Cracked	350	.3	6
Corn.....	Fine	35	1.	20
	Coarse	90	.4	8
	Cracked	400	.2	4
Mixed....	Fine	120	.6	12
(Above)...	Medium Fine	220	.4	8

* Fine; Poultry Mash; Commercial corn meal; Whole Wheat flour.
† Coarse; Dairy cattle feed.

One hour of grinding each day will generally care for a herd of 20 cows. The dust density factor of this method of grinding was negligible as a source of danger from explosion or fire.

One set of fine burrs permits a range in fineness of grinding from whole wheat flour to cracked corn. The energy consumed in grinding a ton of fine grain is two or three times greater than the amount required to grind a ton of the same grain coarse. The small burr mill will not grind roughage or ear corn; it takes approximately three times as much current to grind ear corn as it does to shell and grind the same amount of shelled corn. Burr

replacement, under $1.00, ordinarily is a minor expense; one set of burrs was used in grinding approximately 500 bushels of mixed grain with no apparent damage to the burrs.

Operation

The essential feature of small grinders is that the grinding operation may be conducted without an attendant. The whole grain should be conveyed to the mill by gravity from overhead storage bins. The storage bin may be large enough for only one day's feed supply or in the case of the second story granaries, the mill may be located beneath the main storage bins and the grain spouted direct to the hopper of the mill. The ground grain should drop into a bin or feed truck beneath the mill.

Figure No. 1 illustrates a practical working assembly of the small burr mill and one-half h. p. motor. Both units are mounted on a sawhorse. A small overhead storage bin insures gravity feed to the mill, and the ground grain drops into a feed truck. The feed truck is a galvanized iron stock tank 2-ft. x 2-ft. x 4-ft. mounted on 4-in. wheels.

Burr mills should not be run empty as the cutting edges of the burrs are rapidly worn when the burrs are in direct contact with each other. A magnet in the whole-grain feed line is desirable to keep metal scraps from the burrs.

A flat drive pulley on the motor permits the belt to jump the pulley when the mill is suddenly stopped as may be the case with tramp metal wedged in the grain agitator. This kind of automatic stoppage prevents overheating and damage to the burrs.

The Motor

A one-half h. p. repulsion induction or condenser type motor is recommended for four and one-half inch burr mills. Split phase motors should not be used on jobs of this nature as they do not start well under heavy load.

The motor should be equipped with a circuit breaker switch, six ampere capacity for 220 volts; 12 ampere capacity for 110 volts. The switch furnishes the motor protection from overload and simplifies the starting and stopping operation.

The mounting of the motor should be as simple as possible so that it can be readily moved to different jobs. The greater the number of jobs the larger the return on the investment in the motor.

The one-half H.P. Portable Motor is adapted for use with the grain mill, grain elevator, grindstone, emery wheel, corn sheller, fanning mill, eight-inch power saw, clipping machine, churn, meat grinder, concrete mixer, and paint sprayer. Some of these operations require only one-fourth H.P., but, as they are seasonal in nature and of comparatively short duration, it would be more economical to operate with a one-half H.P. motor than to have an additional investment in two small portable motors of different sizes.

NEW SOY BEAN VARIETIES TESTED

A Report on the Performances of Some Relatively New Varieties

C. R. MEGEE AND H. L. DUNTON, SECTION OF FARM CROPS

Soy bean variety tests conducted during the past 10 years have shown that the Manchu and Ito San varieties deserve first consideration for Michigan conditions. The yields of several other varieties have equaled or nearly equaled those of Manchu and Ito San; but, owing to the lack of commercial seed production, objectionable seed coat color, or low oil content, they have not met with as great favor. Recently, the Mukden, Illini, and Dunfield varieties have come into prominence and it has been thought advisable to compare these varieties with the Manchu and Ito San. These trials were conducted at East Lansing in 1932.

It was possible to secure yields of hay from the varieties in two different stages of maturity. The first cutting was made on September 1, when most of the varieties had produced seeds that were from one-third to one-half developed. At this stage, the leaves had not turned yellow and the plants were of good color and high in protein. The second cutting was made September 22, when the seeds had become three-fourths grown and the stems had become coarse and woody. The yield of hay per acre was higher than from the first cutting, but the quality was somewhat lower. The Table shows the yield of hay when cut September 1, when the pods were one-third to one-half developed, as well as yields secured when the cutting was made September 22 and the pods were well developed, also the yield of seed when the plants were harvested for seed on October 22.

Variety	Yield of hay harvested September 1 tons per acre	Yield of hay harvested September 22 tons per acre	Yield of seed harvested October 22 bushels per acre
Mukden	2.78	3.23	27.38
Manchu	2.50	3.53	22.82
Ito San	2.48	3.25	22.76
Mammoth Yellow	2.46	2.93	None
Illini	2 21	3.28	20.62
Dunfield	1.90	3.12	17.98

The Mukden is a new variety, the seed being offered for the first time in the spring of 1932. The original seed was secured by the United States Department of Agriculture from Mukden, Manchuria, and was increased

by the Iowa Agricultural Experiment Station. When both early and late harvestings are compared, there appears to be little if any difference in yield of Mukden and Manchu for hay production. In this one year test, the Mukden out-yielded the Manchu in seed production. The Mukden is similar to the Manchu in time of maturity and is also very erect in habit of growth.

The Manchu and Ito San are two well known and popular varieties that have been grown in Michigan for a number of years. Seed of the Manchu variety is plentiful and easily obtained.

The Mammoth Yellow variety is not well suited for Michigan conditions. It is very late in maturity and of no value for seed production. It is decidedly inferior to the other varieties for hay, the plants being coarse and woody.

The Illini and Dunfield are well known northern corn belt varieties.

Recommendations

The Manchu and Ito San varieties are being recommended for Michigan again this year. Quite likely, the seed of the Manchu will be the more plentiful of the two. The Mukden is a new variety and has not gained commercial importance but deserves further consideration. The Illini and Dunfield are good varieties but are not so dependable under Michigan conditions as the Manchu and Ito San. The Mammoth Yellow is too late for seed production and too coarse for hay production.

COSTS OF PRODUCING BROILERS AND PULLETS IN 1932

The Methods Used Were Largely Responsible for the Variations in Costs and Returns

K. T. WRIGHT, SECTION OF FARM MANAGEMENT

During the summer of 1932, 51 poultry men kept detailed records on their baby chicks until they were 24 weeks old. These records, when summarized, showed how much it cost to produce pullets and broilers. A special study was made of these records to determine what practices and methods were used by those having the lowest costs and the most profit.

The 48 records that were summarized when the chicks were 12 weeks old showed an average cost of 27 cents a bird. Roughly speaking, one-third of this was the initial price of the chick, one-third went for feed, and the remaining one-third was for labor, equipment, and other costs. The average weight at 12 weeks was 1.8 pounds per bird, therefore it cost 15.3 cents to produce a pound of poultry at broiler age. The average sale price was 13 cents a pound in 1932, so the average poultryman lost money on the broilers.

The 10 men having the lowest cost per pound had an average production cost of 11 cents a pound. The 10 with the highest costs averaged 23 cents a pound. The men with the low costs obtained their chicks an average of May 4 or a month later than the high cost group. The average cost of the baby chicks was $5.50 a hundred compared to $9.80 for the earlier chicks. The low cost group with the later chicks had a mortality of 11 per cent in the 12 weeks compared to 20 per cent on the other group; and, finally, the low cost poultrymen fed 3.2 pounds of feed to produce a pound of poultry, while the other group used 4.9 pounds of feed.

The foregoing figures tell the story of the men having the lowest cost per pound at 12 weeks age. They were not always the more profitable, however, because the later broilers sold for less. In this group of 48 poultrymen, there were only 13 showing a profit when the birds were 12 weeks old. Only four of the low cost 10 appear in this group. A study of the

Fig. 1.—Sanitation and clean ground are very important in raising a high percentage of strong healthy chickens.

profitable group shows a decided tendency toward heavy breeds. These men got their chicks about the middle of April and fed them well so they were ready for the early market and brought a better than average price. Whether one can combine most profitable broiler production methods with the most desired pullet production practices depends largely upon individual conditions. In most cases, the pullets are the major product and they should receive first consideration.

These 51 men keeping records for 24 weeks started with an average of 668 chicks, costing $7.75 a hundred. They were hatched, on the average, about the middle of April, and the broilers were sold 12 weeks later. Out of every 100 chickens started, 44 broilers were sold or used and 40 pullets were saved. The broilers weighed 1.8 pounds when sold and the pullets 3.4 pounds at the end of 24 weeks. About 85 per cent of the men had White Leghorns. The average total cost per pullet at the age of 24 weeks was 53 cents. Of this cost, feed constituted 43 per cent, the baby chicks 23 per cent, labor 14 per cent, and other costs the remaining 20 per cent. It took over 18 pounds of feed, worth 22 cents, to grow the pullet.

Table 1.—Pullet production costs to 24 weeks—1932. The averages are for all farms, for the farms having the lowest cost per pound poultry, and the farms having the highest cost.

Items	Average 51 farms	Average 10 low-cost farms	Average 10 high-cost farms
PER FARM·			
Baby chick cost. . .	$49 92	$46 88	$65 26
Feed cost	94 07	99 76	115 83
Man labor charge	30 93	29 26	39 36
Equipment and buildings charge	15 93	21 46	19 92
Other costs	25 52	17 60	36 64
Total of all items	$216 37	$214 96	$277.01
Credits	279 14	362 71	284.14
Profit or loss .	62 77	147.75	7 13
Pounds of poultry produced	1,453	2,004	1,245
Return per hour labor. .	$0 45	$0 91	$0.18
PER POUND AND PER PULLET			
Feed cost (per lb. poultry) .	6 5¢	5 0¢	9 3¢
Total cost (per lb poultry) . .	14 9¢	10 7¢	22 2¢
Total credits (per lb poultry) . .	19 2¢	18 1¢	22.8¢
Profit or loss (per lb poultry) .	4 3¢	7 4¢	6¢
Total cost per pullet to 24 weeks	53¢	35¢	71¢
Net cost per pullet at 24 weeks	53¢	30¢	90¢
NOTES AND FACTORS:			
Date hatched (average) . . .	4/16	5/5	3/29
Baby chick cost per 100	$7 75	$5 74	$9 88
Number of baby chicks .	668	859	666
Mortality to 24 weeks (per cent)	16 6	11 7	26 2
Were chicks raised on new ground (per cent)	54 9	80 0	50 0
Pullets—Total number .	266	349	234
Number per 100 chicks	40	41	35
Average weight at 24 weeks (lbs)	3 4	3 3	3 2
Males —Total number .	294	409	257
Average broiler age when sold (weeks)	12	12	12
Average broiler weight when sold (lbs)	1 8	1 8	1 9
Average broiler sale price per lb. . . .	$0 13	$0 12	$0 15
Broiler income at 100 chicks	$9 32	$9 46	$8 66
Feed —Pounds of mash per pound of poultry	3 4	3 0	4 3
Pounds of scratch per pound of poultry	2 0	1 4	2 3
Mash value per 100 pounds .	$1 56	$1 31	$1 68
Scratch value per 100 pounds	.83	78	.94

There were extreme variations in the cost of the pullets on these farms. The lowest cost was 28 cents and the highest $1.46 a pullet. The 10 farms having the lowest cost per pound averaged 10.7 cents, making their pullets cost 35 cents each, while the highest averaged 22.2 cents a pound or 71 cents a pullet. Many factors, such as mortality, feeding efficiency, cost of feed, breed of the chicks, date chicks were hatched, and other factors influenced the cost of the pullets.

One-third of the group had less than 10 per cent mortality. The cost per pullet on this group averaged 48 cents. Another one-third lost over 20 per cent of their chicks and they had a cost of 57 cents a pullet. Three factors seemed to be associated with low mortality. The men using clean ground, having light breed chicks, and hatching during the last part of April tended to have a low mortality rate.

The most efficient poultry feeders used 3.5 pounds of feed to produce a pound of poultry, as compared to an average of 5.4 pounds, while the most inefficient used 7.1 pounds. The cost per pullet was 37 cents on the first group and 64 cents on the group using the large amount of feed. There seems to be a tendency for the low feed cost men to use clean ground, get chicks hatched in the last part of April, and have a low per cent of mortality.

There also appears to be a great difference in the ability of the poultrymen as feeders.

There were considerable variations in the costs in various sections of the State. The cooperators in Southeastern Michigan had an average cost of 56 cents a pullet, those in the Grand Rapids-Holland area had a cost of 50 cents, and those in Gratiot and Saginaw counties 41 cents. The major contributing factors were lower mortality, less feed per pound of poultry, and considerably lower cost of the feed in the central section.

A comparison of the 43 farms with light breeds with the six farms having heavy breeds shows the cost per pullet to be 50 cents and 63 cents respectively. The cost per pound, however, was 15.5 cents on the light breeds and 14.1 cents on the heavy breeds. The mortality in the 24 weeks averaged 15 per cent on the light breeds and 23 per cent on the heavy breeds. The broilers of the light breeds were sold at an average of 11 weeks weighing 1.7 pounds for 12.4 cents a pound. The heavy breed broilers were kept until over 16 weeks old, as an average, they weighed 3.0 pounds, and sold at 17 cents a pound.

Reference has been made to the date the chicks were hatched and the costs. About one-fourth of the cooperators obtained the chicks in March. These men had a cost of 64 cents a pullet. The poultrymen getting their chicks the last half of April and the fore part of May had a cost of 43 cents on their pullets. This brings out the manner in which profitable broiler production and low-cost pullet production conflict with regard to date of hatch. In the majority of cases, it is probably advisable to select the date which comes nearest to giving both advantages, and this appears to be the last half of April.

In summing up this study of practices, each farm was graded upon a basis of the number of good practices followed. These measures were as follows: (1) using clean ground for the chicks, (2) having the chicks hatched between April 15 and May 15, (3) selling the broilers at 11, 12, or 13 weeks of age, (4) saving 43 pullets from every 100 baby chicks, and (5) using not to exceed 4.7 pounds of feed to produce a pound of poultry. These standards include approximately the best one-third of the farms in each factor. In this group of 51 farms, there was not a single farm that had a perfect score, based upon these standards. Six farms passed the requirements in four of the standards, and they produced poultry at a cost of 12 cents a pound and pullets for 39 cents. Five farms did not meet the requirements in any one of the standards. The cost per pound of poultry in this group averaged 20 cents and the pullets cost 60 cents each. This seems to indicate that the cost per pullet is dependent almost entirely upon the methods employed in their production.

COST OF PRODUCING EGGS IN 1932

The Laying Flock Records of 40 Michigan Poultrymen Show Wide Variation in Costs and Returns

P. F. AYLESWORTH, SECTION OF FARM MANAGEMENT

The maintenance cost per hen varied from $1.48 to $3.74 on the farms of the 40 poultrymen who cooperated in this farm management study of poultry laying flocks in 1932. These men were better than average poultrymen and secured an average production of 157 eggs per hen compared with the state average of about 94 eggs. The range in net return per hen was from a profit of $1.55 to a loss of $2.14 a hen for the year.

Fig. 1.—Healthy, well matured pullets are a big factor influencing profits in the poultry enterprise.

The average figures of these 40 farms give a composite picture of the entire group. There were 287 hens to start with on November 1 but 19 per cent died during the year and 38 per cent were culled out, so the average number for the year was 220 birds. Seventy per cent of the flock was pullets. Each hen received an average of 84 pounds of feed during the year, 43 per cent of this was mash. The feed bought cost 73 cents per hen and 25 cents worth of home feeds were fed.

It took an average of 1.93 hours labor in a year to care for a hen, or a charge of 29 cents if figured at 15 cents an hour. The difference between (1) the value of the flock at the beginning of the year, and (2) the value of hens used, sold, and on hand at the end of the year gave a decrease of 63

cents per hen. The charge for use of buildings and equipment was 20 cents per hen, and other costs were 31 cents a hen, making a total cost of $2.41 per hen per year. The credits for eggs and manure produced was $2.38 per hen.

The cash costs and depreciation per hen amounted to $1.71 which leaves 67 cents of the $2.38 income to pay for labor, use of buildings and equipment and other non-cash items. A production of 115 eggs per hen at prices received for eggs was necessary to meet cash costs and flock depreciation; while 161 eggs per hen was necessary to meet total costs.

The average cost per dozen eggs, with the production secured by the poultrymen in this study, was 18.4 cents. Feed constituted 41 per cent of the total cost, flock depreciation 26 per cent, labor 12 per cent, use of buildings and equipment 8 per cent, overhead 5 per cent, interest 2 per cent, and other costs 6 per cent. The per cent of these items of the total cost varied only slightly from farm to farm. There was a big variation, however, in total cost per dozen eggs between individual farms which ranged from 11.7 cents to 44.1 cents per dozen eggs.

The 10 flocks having the lowest cost per dozen eggs compared with the 10 high-cost flocks show how this greater efficiency was obtained. The low-cost flocks averaged 194 hens which netted $68.71 profit per farm, while the high-cost flocks averaged 288 hens and showed a loss of $182.87 in the year. The total cost per dozen eggs averaged 12.8 cents in the first group and 23.8 cents in the high cost group. The following differences in favor of the low-cost group were apparent. (1) they had just half as great a flock depreciation due to less death loss and less decrease in value of hens, (2) they secured 18 per cent higher production, (3) employed more efficient feeding methods, and (4) had less labor, building and equipment charge, and other costs.

Factors Affecting Costs and Returns

Sorting the farms according to various factors and practices show their effect on cost per dozen eggs and profits in the enterprise. The number of eggs laid per hen is one of the most important factors and has a direct bearing on the cost of producing eggs and profit or loss in the poultry enterprise. The production per hen ranged from 98 to 220 eggs and averaged 157 eggs for all flocks included in this comparison. The flocks grouped according to egg production are shown in Table 1.

The costs per hen were greatest in the groups with the higher egg production. In the group of eight farms that had an average of 208 eggs per hen, the extra eggs at the price received did not quite pay the added cost. These poultrymen evidently sacrificed efficiency in order to secure higher production. Their feed cost and building and equipment cost was considerable higher than the other groups. The smaller number of hens in this group with the high building charge indicates that they might have accommodated more birds during the year. A greater per cent of the flock was pullets and they spent more labor on the flock. A greater per cent of them yarded their hens and half of them used electric lights. They fed less milk but more mash and a higher priced mash.

In the low production group, only 22 per cent of the hens were culled. These poultrymen could have increased the average production per hen by heavier culling, having a larger per cent of pullets in the flock, and by feeding a better ration. In this group, only 33 per cent of the ration was mash while the high production group fed 45 per cent mash.

Table 1.—Relation of egg production per hen to costs and returns—1932.

Eggs per hen	200 and over	160–199	130–159	Under 130
Average production	208	174	148	118
Number flocks	8	12	11	9
Average number hens	177	216	215	270
Per cent flock pullets	84	79	69	56
Per cent died	15	19	16	25
Per cent culled	37	45	44	22
Electric lights used (%)	50	25	18	67
Hens yarded (%)	75	58	36	33
Liquid milk fed (%)	50	50	64	78
Mash per hen per year (lbs.)	41	38	38	29
Scratch per hen per year (lbs)	50	38	46	59
Feed cost per hen per year	$1 20	$0 99	$0.98	$0 83
Labor cost per hen per year	.42	.30	24	.25
Flock depreciation per hen	.74	.71	.49	.61
Buildings and equipment cost per hen	.34	.15	.18	.19
Other costs per hen	.47	.32	.27	.25
Total cost per hen	$3 17	$2.47	$2.16	$2.13
Total credits per hen	3 26	2 65	2.19	1.75
Total profit per hen	.09	.18	.03	−.38
Total cost per dozen eggs	18.0c	17.0c	17.5c	21.6c
Sale price per dozen eggs	18 5c	17 9c	17.4c	17.3c

There are so many other factors of more importance in determining cost per dozen eggs than size of flock that its effect is overshadowed. It is important to have a large enough flock to utilize available buildings and equipment and to return a sufficient volume of business. The most economical size of flock is dependent to a large extent on the feed, labor, buildings, and equipment available under individual conditions.

A hen normally lays more eggs in her pullet year than any succeeding year. However, it costs more to raise a pullet than is received from the sale of the old hen which the pullet must replace. The proportion of pullets of the flock is therefore an important consideration. One-third of these farms had all-pullet flocks, one-third from 60 to 99 per cent, and one-third less than 60 per cent. The pullet flocks laid 30 more eggs per hen than the flocks with the smallest per cent pullets. The cost per hen was greater in the pullet flocks, but less per dozen eggs due to higher production.

The per cent mortality experienced by the poultryman during the year has a direct bearing on the cost and the net returns. The average mortality of the laying flocks based on the number of birds November 1 was 19 per cent. The mortality per farm ranged from 3 to 39 per cent. These variations were due to disease, improper housing, and general sanitation practices and caused as much as 63 cents a hen difference in net return.

Whether or not using electric lights on the birds is a profitable practice has been a much debated question. The 15 flocks that were lighted produced an average of 10 more eggs per hen. Their costs were higher but their returns greater due to the higher sale price. Their profit per dozen eggs was slightly over 1 cent greater than the other flocks.

The variation in seasonal production is one of the important factors which accounts for differences in sale price per dozen eggs. This variation in seasonal production is the exact reverse of the variation in prices, and is the major cause of price variation. The 10 flocks with an average of over 40 per cent production during November, December, and January had a profit per dozen eggs of 1.7 cents. The other flocks with less production during those months lacked 1.3 cents per dozen of meeting all costs.

Feed constituted 41 per cent of all expenses and therefore offers the greatest opportunity for cutting costs for most poultrymen. The low-cost group, on the basis of feed cost per dozen eggs, purchased their feed cheaper but secured the best production of any group. A larger per cent of them mixed their own ration. The factor that accounts for most of the difference, however, is the difference in ability of the men as poultry feeders.

As a final test to discover the practices followed by the most profitable poultrymen the farms were graded on the following measures of efficiency: (1) an average production of over 190 eggs per hen, (2) over 40 per cent production in November, December, and January, (3) feed cost of less than 7 cents a dozen, (4) less than 10 per cent mortality, and (5) a labor income of over 70 cents a hen. Five farms "made the grade" in four of these measures, and they made a profit of 61 cents a hen. There were 23 that qualified in only one or less and they lost 30 cents a hen.

The practices followed by these five more profitable poultrymen are as follows: They all had Leghorn flocks. The average hatching date of the pullets was the middle of April, they were well matured birds, and gave a production of 47 per cent during the months of high egg prices. There were enough pullets so they could be culled and still have a large enough number to occupy all the building available. Good feeding management was followed to a large extent in that the majority fed liquid milk, cod liver oil, and green feed. Four of the five fed the College ration and used electric lights on the birds.

FARM PRACTICES THAT PAY

The Effect of Certain Farm Practices on Crop and Livestock Returns on Central Michigan Farms in 1931

P. F. AYLESWORTH AND E. B. HILL, SECTION OF FARM MANAGEMENT

There are as wide differences in earnings between individual farms in the same community when returns from farming are low as when they are high. Figures from Central Michigan farms in the Farm Accounting Project show the range in returns per farm. The range in this section of the State in the Operator's Labor and Management Wage in 1929 was from $3,222 to a minus $2,439. In 1931, the range was from $912 to a minus $5,817. In 1929, there was a difference of $1,853 between the average of the most profitable one-third and of the least profitable one-third group of farms. In 1931 the difference between the two groups was $1,938.

By what means are these increased earnings acquired? In some cases, factors out of the control of the farmer affect the financial returns. To a large extent, however, the wide differences which occur in earnings on comparable farms subject to the same price and weather conditions are due

largely to factors over which the individual has control. These differences can be ascribed quite definitely to differences in organization and in certain production practices adopted on the more successful farms. The following standard for measuring a successsful farm has been made from a study of several hundred farms each year in the Farm Accounting Project:* (1) a volume of business as large or larger than the average; (2) enough livestock to balance the crops program and to utilize available labor and buildings; (3) production per cow, hen, sow, and ewe above the average; (4) crop yields per acre above the average; (5) high per cent of tillable acres in the best crops; (6) efficient use of man labor; (7) efficient use of power and machinery; (8) low cost per $100 income.

Factors of efficiency have also been pretty well developed which show how the farms measure up to this standard. Receipts per tillable acre, expenses per tillable acre, amount of livestock per tillable acre, value of crops per tillable acre, dairy sales per cow, and egg sales per hen are some of the most important of these factors accounting for differences in earnings. Very little has been done, however, to show the practices followed by these men in getting higher dairy sales per cow, larger egg sales per hen, and greater value of crops per tillable acre.

For this purpose, a survey blank was prepared on crop and livestock practices. This blank contained questions on the approved practices as outlined by the agricultural departments of the College. It was filled out by the 268 farmers keeping financial records in the general farming area of Central Michigan. They were a group of fairly comparable farms following the same type of farming. There was, however, considerable difference in size of farms so that in making the calculations only the medium sized group of farms were used. There were 80 of these farms ranging in size from 85 to 125 tillable acres.

Table 1.—Data which show the crop production practices followed on eighty farms in Michigan in 1931. (Farms sorted on basis of value of crop production per acre.)

Items	High 20 farms	Low 20 farms
Range in value of crops per tillable acre	$16 57 to $28 86	$6 57 to $10 68
Average value of crops per tillable acre	$20 46	$9 58
Acres legumes plowed under per farm	12 1	4 5
Per cent plowing under legumes	80	15
Pounds of commercial fertilizer per farm	5,461	1,140
Acres covered by commercial fertilizer	39 4	8 6
Per cent using commercial fertilizer	95	45
Loads of manure per farm	231	137
Acres covered by manure	23.2	16 7
Tons of limestone per farm	38 7	13.7
Acres covered by limestone	13 9	10 0
Per cent using certified seed	35	30
Per cent selling certified seed	30	0
Dairy returns per cow	$86	$59
Egg sales per hen	1.31	1 25

*The records of 1012 Cooperators in the Farm Accounting Project were summarized in 1931. The following members of this department helped to start, collect, and summarize the data, E. B. Hill, Head of Department, H. A. Berg, Extension Specialist, A. M. Hauke, Extension Specialist, K. T. Wright, Research Assistant, and P. F. Aylesworth, Research Assistant.

The first sort as shown in Table 1 was made by taking the farms that were in the high 25 per cent according to value of crops per tillable acre and comparing them with those in the low 25 per cent group. The factor of size of farm has been almost entirely eliminated in accounting for difference between the two groups since the high group averaged 104 tillable acres and the low group 105 tillable acres. The organization of the crops program has not been shown in that no recognition was given to the kind and amount of different crops grown. Certain crops require different treatment than others but the practices given were significant in accounting for some of the differences in value of crops produced per tillable acre on farms in Areas 5 and 8.

When the farms were sorted according to dairy sales per cow there was a difference of $87 between the high one-fourth and the low one-fourth of the farms, see Table 2. Some of the outstanding differences between the two groups were; keeping records, selling whole milk, feeding grain on pasture, and using legume pasture.

Table 2.—Data which show the dairy practices followed on eighty farms in Michigan in 1931. (Farms sorted on basis of dairy sales per cow.)

Items	High 20 farms	Low 20 farms
Range in dairy sales per cow....	$101 to $162	$22 to $58
Average dairy sales per cow....	$129	$42
Total number of cows per farm..	12	8
Per cent of cows purebred......	52	20
Per cent owning purebred bull......	85	45
Per cent with over 50% fall freshening...	50	50
Per cent keeping production records....	65	5
Per cent feeding grain on pasture....	90	60
Per cent with legume pasture...	85	35
Per cent watering inside ..	45	10
Per cent selling whole milk. .	85	15
Value of crop production per tillable acre....	$15.02	$13.45
Egg sales per hen..............	1.35	1.24

When the farms were sorted on the basis of egg sales per hen the one-fourth high farms had over three times the return per hen as the low group. The high group had over twice as many hens and raised more chicks per hen. More of the chicks were raised on clean ground and started laying earlier. They were culled oftener and were fed and housed better. The data are given in Table 3.

Tables 1, 2, and 3, show the practices that are significant but do not show just how many dollars advantage they give to the farms following those practices. Another sorting was made of the farms to determine the relative importance of these practices. The value of crops per tillable acre, dairy sales per cow, and egg sales per hen were used to measure this difference in each case. Under crops, an additional sorting was made of those above and below the average of these following the practice. The following tables show the effect in dollars and cents of the different farm practices.

Five of the six crop practices showed a decided advantage in favor of those who followed the practice. The additional return in value of crops per tillable acre ranged from 57 cents to $6.26. In the case of applying lime, there

Table 3.—Data which show the poultry practices followed on eighty farms in Michigan in 1931. (Farms sorted on basis of egg sales per hen.)

Items	High 20 farms	Low 20 farms
Range in egg sales per hen	$2 03 to $3.81	$0 30 to $1.11
Average egg sales per hen	$2.58	$0.82
Number of hens per farm	176	62
Number of baby chicks per farm	441	135
Per cent of baby chicks raised	86	82
Broiler age when sold (weeks)	11	17
Number of pullets put in laying house	155	45
Age pullets start laying (months)	6.1	6.4
Per cent raising chicks on clean ground	60	35
Per cent feeding laying mash	95	60
Per cent using electric lights	35	10
Per cent culling more than once	60	35
Per cent with good henhouse	35	30
Per cent with special market	60	20
Value of crop production per tillable acre	$13.31	$13.70
Dairy sales per cow	82	72

were some farms on very fertile, sweet soil that did not need lime. These farms naturally returned more than those that needed lime. Of the farms where lime was applied, however, those that used more than the average amount received the greatest return. Their return was even greater than those that did not need lime. Likewise in all the practices, those that used more than the average had the greatest value of crops. One must remember, however, that there is a point beyond which additional applications will not

Table 4.—Effect of various practices on value of crops per tillable acre.*

Practices	Number farms	Amount	Number acres	Value crops
Legumes plowed under				
Yes	53	—	11 8	$14 98
Above average	30	—	18 9	15.52
Below average	23	—	6 4	14.26
No	27	—	-	13 19
Commercial fertilizer used				
Yes	60	4,011 lbs.	28 3	15 46
Above average	22	6,868 lbs	47.4	18 44
Below average	38	2,405 lbs.	17 5	13.73
No	20	—	—	11 09
Manure used				
Average	80	191 lds.	20.1	14.73
Above average	33	286 lds.	23 8	15.19
Below average	47	120 lds	15 3	13.80
Lime used				
Yes	45	51 ton	21.0	13.61
Above average	13	114 ton	42.0	16.08
Below average	32	24 ton	11	12.61
No	35	—	—	15.34
Certified seed used				
Yes	25	—	—	15.64
No	55	—	—	13.78
Certified seed sold				
Yes	10	—	—	19.85
No	70	—	—	13.59

Table 5.—Effect of various practices on value of dairy sales per cow.*

Practices	Number farms	Sales per cow
Per cent cows purebred		
Over 50%	25	$100
Less 50%	52	72
Farms with purebred bull		
With	51	92
Without	26	62
Over 50% fall freshening		
With	45	91
Without	32	68
Production records kept		
With	25	112
Without	52	67
Feeding grain on pasture		
With	53	91
Without	24	60
Using legume pasture		
With	45	95
Without	32	62
Cows watered inside		
With	28	94
Without	49	74
Method of selling product		
Milk	41	98
Milk and cream, butter, etc	13	77
Cream	23	53

*Data from 80 farms in Area 5 and 8 ranging in size from 85 to 125 tillable acres.

Table 6.—Effect of various practices on value of egg sales per hen.*

Practices	Number farms	Sales per hen
Raised on clean ground		
Yes	31	$1.83
No	31	1.31
Age start laying		
Less than 6 months	18	1.71
6 months	20	1.67
Over 6 months	22	1.48
Feeding laying mash		
Yes	52	1.77
No	15	.92
Using electric lights		
Yes	15	2.02
No	52	1.45
Culling more than once		
Yes	32	1.91
No	35	1.27
Condition of hen house		
Good	21	1.67
Fair	35	1.65
Poor	11	1.16
Special market		
Yes	24	1.89
No	43	1.40

*Data from 80 farms in Area 5 and 8 ranging in size from 85 to 125 tillable acres.

yield enough to pay the added cost. This point is especially important under adverse weather and price conditions.

Variations in the different production practices in the dairy enterprise caused a difference of from $20 to $45 in dairy sales per cow. The greatest difference occurred in the group selling whole milk, keeping records, and using legume pasture. The market for the product is a factor that the farmer cannot always control. Although those selling whole milk received the most for their product, some men increased their returns by selling butter, cream, and milk to customers rather than selling the butterfat to a dealer.

There was less variation between the different poultry practices in their effect on egg sales per hen. The age the pullets started laying showed the least difference and feeding laying mash the greatest difference. Just half the farmers raised their baby chicks on new ground but those that did had returns of 52 cents more per hen. Only 20 per cent of the farmers did not feed laying mash but they lacked 85 cents of securing as great a return per hen.

The question arises again as to whether a farmer who follows one good practice tends to follow most of the good practices. Study of the combined effect of the different practices on returns gives the answer. The six crop practices in Table 4, the eight dairy practices in Table 5, and the seven poultry practices in Table 6 were used to correlate with returns. The farm-

Table 7.—The combined effect of different practices correlated with the returns from the enterprise.

Practices followed on Crops	Per cent of farms	Value of crops per tillable acre
1 out of 6	3 6	$10 97
2 out of 6	17.8	12 62
3 out of 6	34 5	13 42
4 out of 6	28.6	15.62
5 out of 6	11.9	16 87
6 out of 6	3 6	15 37
Practices followed on Dairy Cows	**Per cent of farms**	**Dairy sales per cow**
0 out of 8	2 5	$28
1 out of 8	5 0	38
2 out of 8	8.8	56
3 out of 8	17.8	67
4 out of 8	17.8	74
5 out of 8	11.4	84
6 out of 8	15 2	103
7 out of 8	19.0	108
8 out of 8	2 5	122
Practices followed on Poultry	**Per cent of farms**	**Egg sales per hen**
0 out of 7	4.4	$0.69
1 out of 7	11.8	.95
2 out of 7	11.8	1 18
3 out of 7	23.2	1.47
4 out of 7	25.0	1.67
5 out of 7	15 0	2.29
6 out of 7	8.8	2.62
7 out of 7	0	0

ers were then divided according to the number of good practices used. The results are given in Table 7.

The combination of several good practices yields greater returns than any single good practice. There is a tendency for some operators to follow most of the good practices. The three farmers who followed all six of the good crop practices had $4.40 greater value of crops per tillable acre than had the three who only followed one of the six practices. The two farmers who followed all eight of the good dairy practices had $94 greater sales per cow than had the two farmers who followed none of the good practices. Likewise the six farmers who followed six of the seven good poultry practices had $1.93 greater returns per hen than the three farmers who followed none of the seven practices.

These are some of the farm practices that pay. They are practices dealing with only three of the farm enterprises but other approved practices may be added which measure the entire farm program. They help account for some of the $1,900 difference in earnings between comparable farms this past year.

JAPANESE BEETLE

Popillia japonica

RAY HUTSON, SECTION OF ENTOMOLOGY

During the past several years, the Japanese beetle, a notoriously injurious insect introduced into the eastern United States several years ago, has been spreading rapidly.

The area infested by this insect has gradually become larger and larger, until now (January 1, 1933) the possible spread in any given year is hard to predict. During the past summer, eight Japanese beetles were captured in the city of Detroit. The State Department of Agriculture and the U. S. Department of Agriculture cooperated to put on an eradication campaign against this infestation after all eggs had been laid. The eradication treatment consisted in the application of several hundred pounds of arsenate of lead per acre in the infested area. The infestation mentioned above is the only one that has been located in the State.

The gradual spread of the insect in the eastern states and the finding of these few specimens in Detroit indicates that within the next few years we shall probably have to contend with this pest, despite the rigid quarantine measures employed by the federal government.

The adult Japanese beetle, as a usual thing, is somewhat larger than the Colorado potato beetle, is of a different shape and color, and has different markings. The adult Japanese beetle is flatter than the well-known potato pest and its body is metallic-green or greenish-brown in color with the exception of the wing covers. These are brown and do not cover the tip of the abdomen, which has five white spots on either side. The size varies between five-sixteenths and seven-sixteenths of an inch in length and three-sixteenths and nine-thirty-seconds of an inch in breadth. The larvae resemble the common white grub found all over Michigan, but full-grown

Japanese beetle larvae are smaller than most species of full-grown white grubs. There is but one generation each year.

The adults usually appear in June and reach their greatest numbers during the month of July, with a few beetles being found as late as the first of October. During July and August, the female beetles lay from 50 to 60 eggs each. These eggs are deposited singly by the female at the rate of three or four per day. In laying her eggs, the female descends into the soil to depths up to three inches. Eggs are more commonly laid in sod or waste lands. These eggs hatch within a period of about ten days and the small larvae hatching from them immediately start feeding on the decaying vegetable matter in the soil and on the roots of plants, particularly the fine roots of grasses. The larvae are full-grown in approximately six weeks. At the approach of winter, they descend into the soil to a depth of six to eight inches and remain there until spring. When the frost leaves the ground, the larvae travel upward and feed until late spring, when they change into pupae, remaining in that stage until June or July and emerging to complete the life-cycle.

Fig. 1.—Adult of the Japanese beetle.

A list of over 200 species of plants has been recorded as hosts of the Japanese beetle in New Jersey. This includes practically all the plants of economic importance in the infested territory. In feeding, certain plants are apparently preferred by Japanese beetles. Among fruits, apple, sweet cherry, plum, grape, and blackberry suffer severely if unprotected, as do shade trees such as linden, birch, sassafras, and willow. Clovers and other field crops are eaten. Smartweed is commonly stripped. Foliage is attacked, and beetles are sometimes found clustered in great masses on such fruits as apples and peaches. Upward of 300 beetles have been collected from a single fruit. The feeding of the Japanese beetle resembles that of the rose chafer, although it has a much larger host-list. The attack on the leaves consists of skeletonization, causing them to become dry and brown giving infested trees a scorched appearance. They also attack flowering plants,

riddling the blossoms. The injury to fruit is primarily upon early-ripening varieties. Apples of the season of the Yellow Transparent are attacked, while peaches ripening at the same time as Rochester suffer severely in heavy infestation. Other fruits ripening at that time are eaten. Green fruit is not eaten so readily.

The larvae, in feeding, seem to feed more commonly on fine-rooted grasses. As a result of this preference, areas in which such grass is grown sometimes suffer severely. Golf courses, lawns, pastures, parks, and cemeteries are commonly infested. The damage resulting from feeding by the larvae of the Japanese beetle is more noticeable in dry seasons than in seasons of normal rainfall. Little damage from this cause, however, has been observed, except where the larval infestation is in excess of 100 per square yard.

The Japanese beetle is capable, then, of causing considerable damage to a wide variety of plants. The experience has been, in infested regions, that plants which can be sprayed with materials such as arsenate of lead can be protected against the adults, not by killing off the beetles, but by acting as repellents. Success in this direction has been especially gratifying in the case of shade trees, where a material known as lead oleate-coated lead arsenate has been developed, which with one application gives protection through the time when the beetles are flying. The turf in areas like lawns, cemeteries, parks, and on golf greens can be grub-proofed by the use of arsenate of lead. The usual way of applying this is by mixing five pounds of lead arsenate with some material like sand and then broadcasting the mixture over the area to be protected. When this is worked into the soil by cultivation or by washing it in water, the results attained have been eminently satisfactory. This treatment is also effective against the common white grub, widely distributed in Michigan, and has everywhere given uniform results without injury, except on certain extremely acid soils. Another treatment consists of soaking the ground with an emulsion of carbon disulphide. This is very efficient, particularly for nursery treatment.

The greatest loss and annoyance from the Japanese beetle has been in the restriction of crop movement caused by the necessity of quarantines to prevent its spread. Comparatively efficient quarantine methods have been developed, consisting in the inspection and certification of farm crops at the point of origin and in the treatment of materials which do not readily lend themselves to inspection. The materials falling in the latter class include nursery stock, for which special methods of treatment have beeen devised.

GLADIOLUS THRIPS

Taeniothrips gladioli

E. I. MCDANIEL, SECTION OF ENTOMOLOGY

The gladiolus thrips, *Taeniothrips gladioli,* is comparatively new to science. The first infestations were discovered during 1930, almost simultaneously in Ontario, Canada, and near Cleveland, Ohio. During 1931, it was reported from various sections of the northeastern United States and Florida, but it was not recognized in Michigan until the spring of 1932. The dis-

tribution in Michigan, though rather general, was "spotted" during the past season, at which time it was not unusual to find fields completely ruined, separated by not more than half or a quarter of a mile from normal, healthy fields. Thrips are insects which thrive in dry, hot weather, and undoubtedly the past three seasons have favored the development of this new pest.

Host-plants—The gladiolus thrips is primarily a gladiolus pest, although it is known to infest certain plants belonging to the *Iridiaceae* and *Liliaceae,** as well as *calendula, Dianthus,* and *Lathyrus.* In Ohio, it has been reported as feeding on plantain, white clover, tomato, cucumber, dandelion, dahlia, hollyhock, delphinium, asters, and iris. In Michigan, during the past season it was not observed in the field feeding on any host plant other than gladiolus.

Description and Life History—The adult thrips measures about one-sixteenth of an inch in length and is black with a band of cream-white at the base of the wing-covers. The mother thrips places her eggs in the

Fig. 1.—Work of gladiolus thrips on foliage and flowers of gladiolus.

tissues of the plant and the young, on hatching, are practically invisible to the unaided eye. There is a decided change in color of the young thrips with each molt, varying from practically colorless through pale yellows to deep salmon or orange. They pass through four stages in their development, the egg, the larva, the pupa, and the adult. When a larva molts, it is either in a cell underground or in some protected place on the plant not exposed to contact sprays (for this reason it is necessary to spray in series of three or four times at intervals of 48 hours). Apparently, it is possible for this insect to develop in storage, since in many instances where comparatively clean corms were stored at temperatures above 60 degrees F. during the winter of 1931-2 many corms became heavily infested during storage. The length of time required to produce a generation depends on temperature and

*1932. Smith & Weigel—A new pest of gladiolus. Journal of Economic Entomology, Vol. 25, p. 315.

humidity. When the temperature is 70 degrees F.,* 17 to 20 days are required to complete a generation, while at 80 degrees F. only 11 or 12 days are required. The optimum temperature for the development of the species seems to be about 82 degrees F. with a humidity between 50 and 70 degrees. Reproduction ceases when the temperature drops below 50 degrees F.

Injury—There are two distinct types of injury, the injury to the growing plants and the injury to the corms in storage.

Where infested corms are planted, the thrips desert the corms for the foliage and flowers, breeding and feeding in the leaf sheaths and unopened flower buds. The work of the "glad thrips" differ from that of all other species of thrips infesting gladiolus in that deep scars are made on the surfaces of the leaves and flowers, the insects apparently confining their feeding to the sap of the plant rather than to pollen. Practically all feeding in the immature stage is done protected by the leaf sheath or flower buds. The majority of adults appear on the foliage late in the afternoon. Where the young thrips attack the unopened buds, the flowers are usually blasted or so distorted as to be worthless. The edges of the petals are withered and much of the coloring matter is removed. The injury to the flowers is much more noticeable on the dark varieties than on the light.

Where infested corms are stored at temperatures above 60 degrees F., the thrips continue to breed. They feed on the surface, killing the cells which eventually develop into a corky layer, which has a russeted appearance. Corms injured by thrips differ from those injured by disease in that the dust-like excrement of thrips is always present, this excrement corresponding in color with the color of the infested corms. Where infested corms are planted, the thrips may collect on the young roots as they elongate and kill them or they may follow the new shoots above the ground and ruin the foliage as well as the flowers. Where severely-infested corms are planted, it is possible for this thrips to multiply, rapidly enough to cause a complete loss of the flower crop or even to kill the plants themselves.

Control—From the above discussion, it is obvious that an effort should be made to plant only corms free from thrips. There are different methods of eradicating thrips on corms without injury to the plants. Several methods will be enumerated, leaving it up to the grower to select the method best suited for his conditions.

Based on information received from Dr. C. A. Weigel of the Department of Entomology, U. S. D. A., the use of naphthalene flakes is considered to be the safest and most effective treatment for "glad thrips" on stored corms.

Naphthalene Flakes—One ounce of naphthalene flakes is sufficient for 100 corms, or one pound for 2,000 corms. In the former instance, place the corms in a paper sack, box or keg; in the latter instance, the flakes may be scattered over the corms in the trays and the stacked trays covered with heavy paper or canvas. Where tight containers are used, there is a tendency for the corms to sprout. The corms may be treated for two or three weeks, after which they should be aired and the excess naphthalene removed. Corms are always subject to reinfestation if brought in contact with contaminated stock.

*Smith & Weigel—A new pest of gladiolus. Journal of Economic Entomology, 25; 315. 1932.

WARNING:—*There is a certain amount of risk in using naphthalene, especially if the fumigation is continued too long or the corms are too closely covered.*

Calcium Cyanide Fumigation—The amount of calcium cyanide used depends on how nearly the room or chamber can be made air-tight. The dosage varies from 1½ to 5 ounces per 1,000 cubic feet of air space, depending on how tight it is possible to make the chamber. Usually 2½ ounces of calcium cyanide to 1,000 cubic feet of air space is a safe dosage. Since calcium cyanide does not affect the eggs, a second fumigation is necessary and the time elapsing between fumigations depends on storage temperature. Where corms are stored at 70 degrees F., the fumigation should be repeated after an interval of 10 days. At 60 degrees F. about 15 days' time is sufficient, and where the storage conditions are 50 degrees F. or below a second fumigation is seldom necessary. *Calcium cyanide, when exposed to the air, liberates hydrocyanic acid gas, one of the most deadly gasses known. It cannot be used around dwellings or livestock and precautions must be taken in handling it not to get it on the corms.*

Mercury Compounds—Mercury compounds cannot be used when corms are to be sent through the mail, but, in the spring just before planting, the grower can treat any suspected stock with one of the mercury compounds, such as Semesan Bell or bichloride of mercury. When Semesan Bell is used, follow the directions for potato dip given on the container.

Bichloride of Mercury (Corrosive Sublimate)—Where corms are soaked for two to three hours in mercuric bichloride diluted one ounce to eight gallons of water, practically all thrips will be killed. Mercury bichloride breaks down when it comes in contact with metals; therefore, it must be used in either an earthern, wooden, or enameled container. Where metal has to be used, see that it is coated with either paraffin or asphaltum. This chemical is very poisonous; therefore, care must be taken to prevent accident.

Carbon Disulphide Emulsion—Where mealybugs are also present, corms submerged in 50 per cent carbon disulphide emulsion, made according to the formula prescribed for Japanese beetle diluted 1 to 1,000 (temperature of bath 100° F.) for from 30 minutes up to three hours will be free from both thrips and mealybug.

On Growing Plants

Before applying any contact spray to growing plants, be sure to cut and remove all flowers from the field. Of the various spray combinations tested, the following formula was found to be the most satisfactory during the season of 1932:

Lead arsenate	3½ ounces
Derrisol	4 ounces
Glue	1 pound
Water	10 gallons

Other combinations using pyrethrum compounds in place of Derrisol also gave commercial control. Of all the spray combinations employed where lead arsenate and glue were used, at least a 95 per cent control was obtained.

In flower gardens where it was possible to water and to use fertilizer in combination with the spray program, the loss from thrips was negligible. *To check an epidemic of thrips it is necessary to spray three or four times at intervals of 48 hours.* It is desirable to apply any spray with a pressure of at least 30 pounds, and 60 pounds pressure is desirable.

Some growers found the Canadian formula,* developed by Gibson and Ross quite satisfactory. This spray should be applied as a mist and not enough applied to cause the plants to drip. The formula is as follows:

2 tablespoonsful	Paris green
2 pounds	Brown sugar
3 gallons	Water

WARNING:—*Whatever spray formula is used, start the applications as soon as the thrips are discovered. Spray in sets of three or four applications. Spray on alternate days.*

Irrigate if possible. Use fertilizer to stimulate growth.

Do not plant glads on ground or near where infested glads grew last year.

Do not interplant glads with German or Japanese iris. The "glad thrips" is said to attack both these plants.

Keep the flower crop cut.

MAKING SPRUCE-FIR LAND PROFITABLE†

Care in Logging Is An Important Step in Growing Pulpwood

R. H. WESTVELD, SECTION OF FORESTRY

Approximately two and one-half million acres of forest land in northern Michigan is classed as spruce-fir forests. This implies that on 13 per cent of the forest land of Michigan, black spruce, white spruce, and balsam fir are the predominant species. In addition to this class of land, there is a considerable acreage of aspen land that supports a generous quantity of spruce and balsam as an under story, which, if properly handled, could be made highly productive of pulpwood species. A large proportion of this pulpwood land is unfit for agriculture and yet it has a high potential value for growing trees. It is in many cases a more promising prospect for timber production than many other types of forest land because it produces species that can be marketed in small sizes, which means that marketable trees can be produced in a fairly short length of time. Trees five inches in diameter are large enough for pulpwood, and, on the more productive land, such trees can be grown in less than 20 years.

*Gibson and Ross. Insects Affecting Greenhouse Plants, Dominion of Canada, Department of Agriculture, Tech. Bul. No. 7, n. s., p. 37.

†First of a series of articles on the subject of growing pulpwood based on studies now in progress.

Types of Spruce-Fir Land

Spruce-fir lands in Michigan present a variety of conditions. Some of them have never been cut over. These uncut stands may be producing at full capacity but more often they are not. Cut-over lands usually support a scattered stand, or they may be practically denuded, especially if fire has gotten into the area after cutting. Then there is another class of land, that which has grown up to a dense stand of aspen under which has developed a stand of spruce and fir. All of these conditions represent different problems in management, and, therefore, call for separate treatments. The proper treatment of merchantable stands which are to be cut is of first importance, because their future productivity depends to a large extent on how they are handled at the time of cutting. One of the most destructive forces in cutting operations is carelessness in logging. It accounts for the destruction of large quantities of young growth which, if preserved, would form a nucleus for a new crop.

Extent of Logging Damage

The amount of damage done to seedlings and small trees in the process of logging will vary somewhat, depending upon the care which is exercised in carrying out the various steps. Examples of excessive damage are probably more numerous than those of moderate damage. The following table shows what happened to seedlings on two typical logging areas where no attention was given to preventing damage. These figures are based on careful counts on sample plots before and after logging.

Table 1.—The percentage of seedlings destroyed in logging on two typical areas.

Size Class	Area I			Area II		
	Spruce	Balsam fir	White cedar	Spruce	Balsam fir	White cedar
Height—Feet	Percentage of seedlings destroyed in logging					
.1– .5	60.0	58.4	68 8	0.0	81.5	94.2
.6–1.0	(a)	0 0	86.7	(a)	50 0	100.0
1.1–2.0	(a)	(a)	83.4	(a)	100.0	100.0
2.1–3.0	(a)	(a)	100 0	(a)	(a)	100.0
3.1–5.0	(a)	(a)	100.0	(a)	(a)	100.0
5.1–10.0	(a)	(a)	100 0	(a)	(a)	100.0
Average—all sizes	60.0	57.7	72.7	0.0	73.7	95.7

(a) None present before logging.

It is obvious that the destruction of seedlings is uniformly high. The one example of no loss of spruce reproduction on area two is of little significance, as only one seedling was present prior to logging, whereas the other size classes were represented by large numbers of seedlings. Average losses ranged from 57.7 to 95.7 per cent. This variation in logging damage is due to the location of the plots and the position of the seedlings with reference to logging roads. The bulk of the loss of seedlings occurs on and adjacent to the logging roads. In one instance, where a recently cut-over area was examined in detail, it was found that 39 per cent of the ground surface was covered by logging roads upon which all reproduction was killed. The re-

mainder of the damage comes from cutting out reproduction in getting the pulpwood to the roads.

All size classes of seedlings are subject to damage. As a matter of fact, the larger size classes show the highest percentage of loss. Small unmerchantable trees are subjected to as much destruction in logging in some cases as the seedlings. On the plots on which the seedling damage was studied, no trees under five inches in diameter were cut intentionally, so the damage to these small trees was studied. The destruction of these trees varied from zero to 81 per cent of the total number of trees, and, in most instances, was between 60 per cent and 70 per cent. These small trees represent a very real loss, since it is the one to four-inch trees which form an important nucleus for another cut in 10 to 20 years. The more of these trees that can be preserved in logging, the greater will be the harvest at the next cut.

Preventing Excessive Damage

The destruction of the young growth which would keep much of the spruce-fir land productive in northern Michigan is frequently not intentional. The owner of the land simply does not realize how much damage is occurring and may not appreciate the fact that much of this loss can be avoided. The first step in a logging operation, where damage can be avoided, is in felling the trees. Small unmerchantable trees growing close to the trees to be felled are often cut down for the convenience of getting at the tree to be cut. Except where small trees are so close as to interfere seriously with felling, such trees should be protected. Little attention is usually given to the location in which the tree is allowed to fall. Unless some attention is given to this, the falling tree is just as likely to fall upon and break some small unmerchantable trees as to fall in an open space. Carefully sizing up the position in which the tree can be felled will prevent much of this loss.

Finally, the losses of both seedlings and small trees now occasioned in removing the pulpwood from the cutover tract can be avoided. This can be done by carefully laying out the logging road, as much as possible to avoid, running through the clumps of reproduction or small trees. These roads should also be kept as narrow as is compatible with efficient logging. Furthermore, in skidding pulpwood to the road, the number of trails should be kept to a minimum. In a large logging operation, all of the foregoing precautions cannot be rigidly enforced because of the difficulty of supervision; but on the farm woodlot tract, where the owner usually does all of the cutting and logging, these precautions can easily be carried out at no cost and at a considerable saving of valuable young second growth.

MICHIGAN CONTEST COMPLETES TENTH SUCCESSFUL YEAR

High Producing Hens Show Profit Despite Low Egg Prices

E. S. WEISNER, SECTION OF POULTRY HUSBANDRY

The Tenth Annual Michigan Egg Laying Contest which closed September 21, 1932, again supplied a fund of information which may be studied with interest by any one raising poultry as a farm enterprise. As in the past, the contest consisted of 100 entries of 13 birds each, comprising six breeds and varieties. These birds were representatives of 85 flocks from this and other states.

All birds entered were trapnested and individual production records were obtained. Additional data collected were figures on number of eggs sold, price per dozen, total receipts, the number and causes of death and amounts of feed and materials used. These data are summarized in Tables 1 to 3.

Table 1.—Number of birds, breeds, feed consumption, average production and deaths for the year

Breed	No. birds	Feed consumption *per hen	Average †production	No. deaths	Per cent mortality
B. Rocks.........	182	104.68	191.2	35	19.2
W. Rocks.........	91	107.71	143.8	31	34 0
W. Wyandottes...	13	106.82	207.6	2	15.4
R. C. R. I. Reds..	13	95.89	186.4	5	38.4
S. C. R. I. Reds..	65	103.65	185.6	13	20.0
Leghorns.........	936	98.19	207.8	213	22.7
All Breeds........	1,300	99.66	199.53	299	23.0

* Feed consumption includes: Grain, mash, semi-solid buttermilk, oyster shell, grit and charcoal.

† Average production based on ten high individuals in each entry; mortality figured from all birds entered.

Mortality during the year showed a slight increase over that of the previous year. There were 299 deaths or an increase of .54 per cent over last year. A complete analysis of the autopsy records substantiates the belief that an increasingly greater number of birds show diseases and abnormalities affecting the reproductive organs. Breeding and feeding for continuous heavy egg production may explain this condition in part. However, the theory has been advanced by some of the leading poultry pathologists that, Pasteurella avicida, the causative organism of fowl cholera may be the underlying factor. At least 30 per cent of the birds subjected to autopsy showed lesions or conditions to be listed in this group. Other diseases contributing toward the 23 per cent mortality are sarcomatosis, leucosis and peritonitis.

Table No. 2.—Eggs sold and value per month with average price per dozen.

Month	Per cent production	Total dozen	Value	Average selling price	No. deaths by months
October	42.8	1,090	$294.50	$.27	13
November	51.8	1,316	422.69	.336	16
December	50.7	1,317	398.83	.302	19
January	58.33	1,483	321.25	.216	27
February	67.2	1,733	314.02	.181	19
March	70.6	1,963	288.02	.146	33
April	69.67	1,810	244.62	.1329	31
May	69.64	1,859	242.22	.13	27
June	66.7	1,734	228.82	.1318	33
July	59.93	1,504	210.26	.139	28
August	52.8	1,466	243.77	.173	27
September	43.3	785	143.49	.182	26

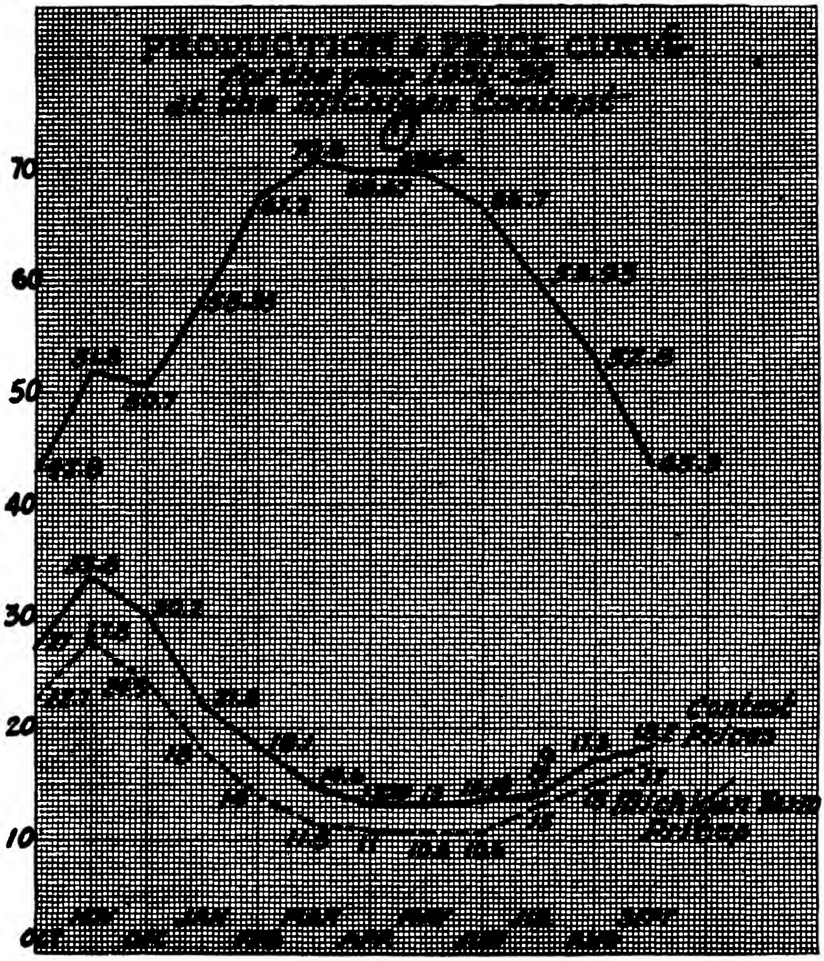
Average................................18.08 cents

Several interesting points are brought out in Table 2, which gives production percentages, total dozen eggs marketed, receipts, average selling price per dozen, and the number of deaths by months. All production percentages are based on 1,000 birds as the 10 high individual records are taken in each entry as representative of the unit. The curve of production conformed to that of past years, reaching its peak in March and April and was lowest in September and October. Prices were highest in November and lowest in June, showing a slight deviation from past years in that the price of eggs began to slump somewhat earlier and that the increase beginning in July was much less pronounced.

Very significant are the figures carried in Table 3, showing amounts and costs of feed consumed, when combined with those in Table 2 showing egg production and prices. The cost of carrying the individual hen through the year was $1.51, a reduction of $0.45 per bird under 1930-31, reducing the cost of a dozen eggs from $0.14 to $0.096 per dozen. The average selling price was a trifle over $0.18 per dozen, some $0.07 under the 1930-31 average, leaving a return of $0.0848 per dozen or $1.41 per hen to cover labor. housing and other overhead charges. Thus, it is apparent that with high producing birds, properly housed and fed, a substantial return on the in-

Table No. 3.—Feeds and materials, used, amounts of each, average price per unit and total cost.

Material	Amount	Price	Total
Scratch grain:			
Corn	10.95 Tons	$20.00 per Ton	$219.00
Wheat	10.95 Tons	.48 per Bu.	175.20
Mash	26.21 Tons	30.00 per Ton	786.30
Straw	12.00 Tons	6.00 per Ton	72.00
Semi-solid	11,565 Lbs.	2.10 Cwt.	242.86
Cod liver oil	40 Gal.	.70 Gal.	28.00
Oyster shell	4,166 Lbs.	.90 Cwt.	37.49
Grit	2,282.4 Lbs.	.90 Cwt.	20.54
Charcoal	375.75 Lbs.	2.25 Cwt.	8.45
Cartons	12,000	12.00 M.	144.00
Egg cases	40	.20 Each	8.00
Total			$1,741.84
Cost of feeds and materials per hen			1.51
Return above costs			1.41
Cost per dozen eggs			0.096



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vestment can be realized even through a period of exceptionally low prices. It is also obvious that the practice of reducing potentially high producing flocks to a wild state, by withholding proper feeds, the subsequent reduction in their laying power places them to such disadvantage that a profit cannot be realized.

COMPARISONS OF NEW AND OLD MATERIALS FOR SCAB CONTROL

W. C. DUTTON, SECTION OF HORTICULTURE

The thoroughness of spray application and the proper timing of these applications are often said to be the most important considerations in the control of apple scab. It is true that these two factors are of prime importance; also, it is true that many growers can succeed in some years with the less effective materials and that a few growers are successful with such materials even in years when apple scab is epidemic simply because they spray very thoroughly and at the proper periods. Similarly, many growers fail miserably in epidemic years even with the most effective materials, principally because they do not spray properly. It requires the combination of accurate timing and reasonable thoroughness of application and conditions especially favorable for scab development to put the materials themselves to a crucial test.

There have been tests each year of the newer materials but for several years there was not enough scab in the experimental orchards to afford opportunity for a satisfactory test. In 1932, however, the conditions were amply severe. A large number of materials and combinations were used in two orchards, one at Morrice and the other at Belding. At Morrice, the variety was Jonathan and at Belding records from Jonathan and McIntosh are available. The materials that were compared are flotation sulphur, Ansul sulphur, calcium sulphide (Cal-Mo-Sul), ground sulphur, and bentonite sulphur (Kolofog) used in comparison with various concentrations of lime-sulphur.

At Morrice, flotation sulphur, bentonite sulphur, Ansul sulphur, and low concentrations of lime-sulphur all gave reasonably satisfactory results on Jonathan, a scab resistant variety, but with considerable differences in the amounts of foliage injury. The spraying was thoroughly done and scab was not really severe, as shown by the fact that 19 per cent of the unsprayed fruit was free from scab. In sharp contrast were the results obtained at Belding on Jonathan and McIntosh where scab developed in epidemic form because the spraying was done less thoroughly than at Morrice. The results in this orchard are especially interesting because of the marked differences in scab control on the two varieties which were sprayed alike in every instance.

In considering the results at Belding it should be remembered that the coverage was not as complete as at Morrice, thus accounting, in part at least, for the differences in control on Jonathan. However, the spraying was undoubtedly as well done as it was in many commercial orchards in Michigan in 1932, and, for that reason, the results obtained there are more generally representative than if an extremely thorough job of spraying had been done.

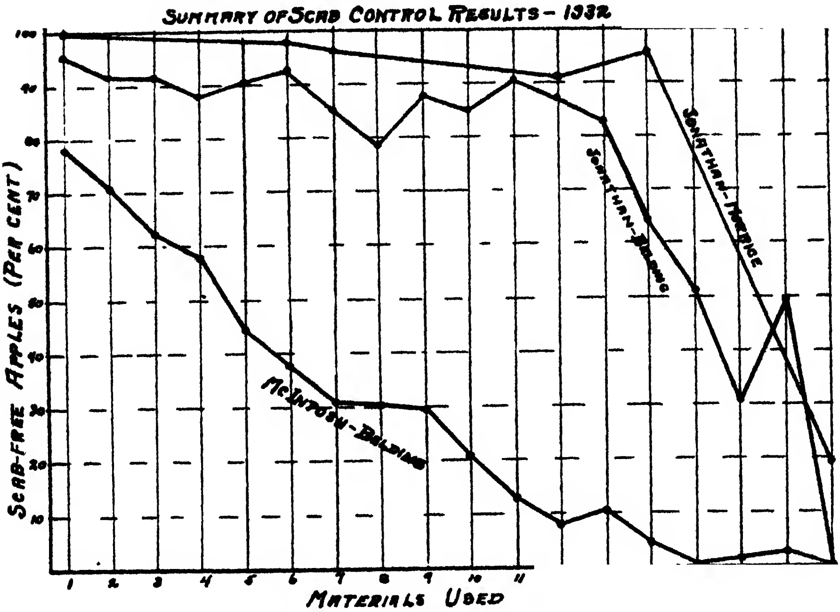
The percentage of scab-free apples with the various treatments are shown in the accompanying Table and Graph. These data will be discussed from

Control of Apple Scab—1932

Plot	Materials and Concentrations	Scab-free fruit per cent		
		Belding		Morrice
		McIntosh	Jonathan	Jonathan
1......	Lime-sulphur (2½–100)..	78.2	95.7	98.9
2......	Lime-sulphur (2½–100) in pre-blossom and flotation sulphur-wettable (5–100) in post-blossom applications	70 6	92.0	
3....	Flotation sulphur-paste (15–100)..	62 3	91 6	
4..	Flotation sulphur-paste (10–100).. . .	57 7	87 7	
5	Lime-sulphur (2–100) in pre-blossom and mixture of lime-sulphur (1–100) and Cal-Mo-Sul (6¼–100) in post-blossom applications	44 6	90.5	
6 . .	Lime-sulphur (2–100) in pre blossom and (1–100) in post-blossom applications . . .	37 7	92 9	97.7
7.. . .	Flotation sulphur-wettable (6–100)	31 3	85 0	96.1
8..	Flotation sulphur-wettable (4–100)	30 3	78 9	
9.. .	Lime-sulphur (2½–100) in pre blossom and Ansul sulphur (3–100) in post-blossom applications... .	29 8	87 7	
10....	Lime-sulphur (2–100) in pre-blossom and Cal-Mo-Sul (12½–100) in post-blossom applications . .	21 0	85 0	
11.... .	Lime-sulphur (1–100)......	13 0	91 0	
12.....	Kolofog (8–100).	7.7	87.4	91.0
13.. .	Ansul sulphur (4–100)..	10 6	83.1	
14.. ...	Ansul sulphur (3–100)...	4 7	63.4	95 5
15......	Ansul sulphur (2–100)......	0.3	51.7	
16......	Ansul sulphur (1–100)......	1.6	30 6	
17......	300 mesh sulphur-wettable (8–100).....	2.9	49.6	
18......	Check..	0	0	19.0

three points of view: (1) differences in materials, (2) varietal differences, and (3) thoroughness of application.

Effectiveness of Materials—In order to afford a real test for scab control, a material must be used on a susceptible variety in a year when scab develops seriously. On that basis, the results from Belding on McIntosh can be used. No material gave complete control because the coverage



was not adequate, but, as previously pointed out, the spraying was undoubtedly as well done as in a large proportion of Michigan orchards. The data for McIntosh show that the materials were effective in about the order in which they are listed in the Table. Lime-sulphur (2½-100) obviously was the most effective and lower concentrations of lime-sulphur gave unsatisfactory results. Of the other materials used, flotation sulphur seems to be the best and this sulphur is undoubtedly more effective in the paste than in the form of a wettable powder. Cal-Mo-Sul did not show great promise under severe conditions, though the combination of it with weak lime-sulphur was better. Bentonite sulphur (Kolofog) gave very unsatisfactory results on McIntosh when used throughout the season. Instances are known, however, where this material gave good results in the after-blossom applications, where thorough applications of lime-sulphur had been made in the pre-blossom sprays. Ansul sulphur gave such poor results on McIntosh that it seems doubtful if it is entitled to very serious consideration for apple spraying in Michigan. The 300-mesh sulphur, with the exceptions of the lower concentrations of Ansul sulphur, was the least effective material used.

Varietal Differences—Considering Jonathan, it is seen that all materials in the list in the orchard at Belding down to and including Ansul sulphur (4-100) gave reasonably good control, and, if the spraying had been more thoroughly done, the control in all these plots (1 to 13 inclusive) would undoubtedly have been satisfactory under the conditions that prevailed in that orchard. It is evident, therefore, that there are extreme differences in the spraying procedure necessary to control scab on different varieties under the same orchard conditions. These results show definitely that many materials that are not at all satisfactory on McIntosh can be counted on to give good results on Jonathan (or other similarly resistant varieties), even with indifferent spraying. The advisability of varying the spraying practice according to varieties will depend largely on the orchard layout. If there are entire

orchards or even blocks of varieties of similar susceptibility, variations can be made to advantage. If susceptible and resistant sorts are interplanted, it will usually be desirable to let the most susceptible variety determine what the spraying procedure shall be.

Thoroughness of Application—A comparison on the basis of thoroughness of application is available with Jonathan in the two orchards. The essential difference between these two orchards was in the completeness of the coverage. At Morrice, all the materials used gave better control than the same materials at Belding, indicating that thoroughness of application is very essential, even with a variety as resistant as Jonathan. The fact that 19 per cent of unsprayed fruit at Morrice was scab free may indicate that the disease was a little more easily controlled there.

Summary

Thoroughness and timeliness of application are always extremely important in scab control operations. With susceptible varieties in epidemic years, the material is almost equally important in the hands of most growers. Though variations in procedure are often possible and desirable in order to avoid as much injury to foliage and fruit as possible and still control apple scab, definite recommendations cannot be made because such variations must be determined by each grower. The safest procedure with any variety is to do very thorough work with a standard, effective material, such as lime-sulphur, in the pre-blossom applications to prevent the primary infection which most often occurs before the petal-fall period. It is often possible in the after-blossom applications gradually to lower the concentration of the lime-sulphur or to substitute some other material. This should be done, however, only if scab has been held well in check in the pre-blossom period and when the bulk of ascospore discharge has occurred previous to the petal-fall period.

Fruit growers, when considering the merits of new materials, should consider the conditions under which the materials have been tested, whether the tests were made on a resistant or a susceptible variety, whether they were made in an orchard where scab developed seriously or in a year when scab was epidemic, and whether they were used for all or only part of the applications. Many spraying materials are what might be called "fair weather friends," which means that they give good results with resistant varieties, with susceptible sorts in years when scab is not severe, or with frequent and heavy spraying but fail miserably with susceptible varieties in epidemic years or with less frequent application.

THE FERTILE HALE PEACH

STANLEY JOHNSTON, SECTION OF HORTICULTURE

A number of years ago, Lawrence LaDuke, who lives on a fruit farm near Lawrence, Michigan, ordered some J. H. Hale peach trees from the William P. Stark Nurseries of Stark City, Missouri, a few years after that nursery had introduced the variety. After the trees came into bearing, Mr. LaDuke noticed that a few of them were somewhat more vigorous in growth and more reliable in production than the others in the orchard. In 1928, he

called this to the attention of Roy E. Gibson, who has charge of the Research Department for the Greening Nursery Company. Mr. Gibson at once began an investigation of the situation and from time to time was given assistance by members of the Department of Horticulture of the Michigan State College.

Observations in the LaDuke orchard in 1928 at blossoming time showed that a few of the trees produced blossoms having free pollen. The remainder of the trees in the orchard produced blossoms having the typical hardened anthers of the J. H. Hale and from which no free pollen could be obtained. The trees of these two types were marked and subsequent examinations at fruiting time in 1928, 1930, and 1931 (in 1929 there was a crop failure) showed that the first type having the perfect blossoms produced uniformly perfect peaches and no "buttons," while trees of the second type produced many "buttons." In these investigations, the first type was designated as the Fertile Hale while the second type was called the Sterile Hale. Progeny trees, propagated from the parent trees in the LaDuke orchard and now in bearing on the South Haven Experiment Station grounds, reproduce tree, flower, and fruit characters of their parents.

The exact origin of the Fertile Hale is in one sense uncertain. In view of what is known to be the common methods employed by commercial nurseries in propagating the peach, however, the presumption is that the trees of the fertile type found in the LaDuke orchard originated as a limb or tree variation of the J. H. Hale. At any rate, the Greening Nursery Company decided to propagate and distribute the variety under the name of Fertile Hale.

Following is a description of the Fertile Hale more or less in terms of the J. H. Hale variety.

Tree—The trees of Fertile Hale are somewhat more vigorous than those of J. H. Hale, and the old trees of the former variety have shown no special weaknesses.

Blossoms—Fertile Hale blossoms have free pollen and are self fertile, while just the opposite is true of J. H. Hale.

Fruit—The fruits of the two varieties are about equal in size. Both the yellow ground color and the red cheek of the J. H. Hale are somewhat brighter than the Fertile Hale, although the latter must be considered an attractive peach. The suture line is deeper in the Fertile Hale, particularly at the apex. The color of the flesh of the two varieties is about the same. The Fertile Hale does not show as much red at the pit. The Fertile Hale pit is slightly larger and lighter colored than the J. H. Hale pit. The Fertile Hale has a little more pronounced flavor then the J. H. Hale and the quality can be considered very good.

Season—The Fertile Hale is apparently about three days later in maturing than the J. H. Hale.

Though the Fertile Hale resembles the J. H. Hale very closely, the prospective grower should realize that there are some differences and that buyers on the market may make a distinction between the two varieties. From the growing standpoint, the Fertile Hale has the qualifications of a good variety. Its advantages over J. H. Hale are in its more vigorous growth and its self-fertility. The J. H. Hale has a somewhat brighter appearance. Considering all factors, the Fertile Hale is well worthy of trial.

FREDONIA—A PROMISING BLUE GRAPE FOR EARLY MARKET

NEWTON L. PARTRIDGE, SECTION OF HORTICULTURE

Fredonia, a cross between Champion and Lucile, was produced at the Fredonia Laboratory of the New York Experiment Station in 1915. A number of these vines were set in Berrien and VanBuren counties in the spring of 1928 and now have come into production. Most of them were placed in vacancies of old vineyards and have not come into full production. Those which were set away from old vines are bearing crops that are approximately equal to Concord grown under similar conditions. It is reported to be a heavy producer in New York with yields as large or larger than Concord.

Fredonia is an early variety, its fruit ripening at about the same season as Champion when grown on similar soils. The fruit is of very good flavor, being the equal of Concord and much better than that of any of the other blue grapes of similar season. Since the berries have tough skins, they pack well and remain in good condition if permitted to remain on the vine for some time after they are ripe. The picking season thus may extend over a period of several weeks, extending into the season of Concord. The bunches are of medium size with fairly large berries.

Champion has been a rather profitable variety in Michigan in spite of its low quality because of its early season. Fredonia seems likely to supplant this variety because of its better quality and equal productiveness. It is not probable that Fredonia will be grown extensively because the demand for early grapes has been limited. Its long season and attractive characteristics make it very desirable for sale at roadside stands and its firm skin enables it to stand shipment well. The shorter season required to bring it to maturity will permit Fredonia to be grown farther north than Concord. It is recommended for trial on a modest scale.

NITROGEN FIXATION IN SOME MICHIGAN SOILS

L. M. TURK, SOILS SECTION

Larger quantities of nitrogen than of any other plant food element are used by many crops. In most soils, the supply of nitrogen is very limited. Furthermore this element is the most difficult to keep in the soil, since, under favorable conditions, it becomes soluble and is carried away in the drainage water or it may pass into a gaseous state and escape into the atmosphere. In planning a soil management system, therefore, it is essential that consideration be given to methods by which nitrogen is added to the soil.

The process of obtaining nitrogen from the air through the activities of

nitrogen-fixing bacteria living in nodules on the roots of legumes has been studied a great deal. Much less attention has been given to the process of enriching soils through the activities of nitrogen-fixing bacteria which live in the soil but not in association with the roots of any plant. It is the object of this paper to report the results obtained by a study of this method of nitrogen fixation in several Michigan soils.

The fact that nitrogen may be gathered from the air and fixed in the soil by the activities of micro-organisms was first established over 40 years ago. Nitrogen fixation by free-living independent organisms, that is, independent of the common crop plants, is commonly called non-symbiotic fixation.

The power of non-symbiotic nitrogen-fixation is possessed by a large number of different soil organisms, but, from the data now at hand, it appears that the Azotobacter and Clostridium groups are the more important ones. Azotobacter are large, spherical, aerobic organisms requiring oxygen for their activities and they will thrive and fix nitrogen only in soils fairly well supplied with lime. This group is represented in the soil by a number of different species which vary greatly in their nitrogen-fixing ability. The members of the Clostridium group are rod-shaped and are anaerobic (capable of functioning in the absence of free oxygen). This group is able to withstand and remain active in soils of a much higher degree of acidity than the former group. These two groups of micro-organisms are widely distributed over the earth's surface; they have been noted in practically every locality from which soils have been examined. The general soil conditions most favorable for the successful operation of the non-symbiotic nitrogen-fixation processes are: (1) supply of food for energy production, (2) a suitable temperature, (3) the presence of adequate soluble mineral food elements, especially phosphates, (4) suitable moisture conditions, and (5) a desirable supply of basic material such as ground limestone, marl, or other form of calcium.

Since the discovery of these non-symbiotic nitrogen-fixing bacteria many studies have been made relative to their distribution in soils and their importance in the maintenance of the nitrogen supply of soils. Such investigations, however, as far as the writer is aware, have never before been made for any of the soils of Michigan.

Economic Importance of Non-symbiotic Nitrogen Fixation

It is evident that the importance of nitrogen fixation is largely dependent upon the numbers and kinds of nitrogen-fixing organisms in the soil and the nature of their environmental conditions. From the time the aerobic organisms were discovered, they have been considered to be of the greatest economic importance in cultivated soils. That generally accepted idea does not appear to be supported by sufficient experimental data to warrant such a conclusion. Recent investigators have been led to believe that the anaerobic nitrogen-fixers are of greater importance in adding nitrogen to soils than has generally been supposed.

The aerobic organisms are absent in many soils and may be relatively inefficient in others, whereas, the anaerobic organisms have been considered unimportant except in abnormal soils which are poorly drained and unsuited for cropping, although they may be present in most soils. There is no conclusive evidence, known to the writer, regarding the question of the actual importance of these two groups (aerobic and anaerobic) of nitrogen-fixing organisms in maintaining the nitrogen supply of field soils.

According to statements usually made in the literature, non-symbiotic nitrogen-fixing bacteria add, under favorable conditions, 15 to 40 pounds of available nitrogen to each acre of soil yearly. Some investigators have reported much greater fixation than the quantities just given. Due to the fact that it is almost impossible to detect by present laboratory methods even appreciable increases in the nitrogen content of soils (such as 30 or 40 pounds per acre per year), the real agricultural importance of the non-symbiotic organisms is practically unknown. If one remembers that it requires 200 pounds of 20 per cent ammonium sulfate to furnish 40 pounds of nitrogen per acre, the importance of nitrogen fixation may be better realized. No doubt considerable nitrogen fixation will take place in most soils if provision is made for correcting soil acidity in very strongly acid soils, and for a proper food supply to give the organisms the amount of energy which they demand.

Plan and Purpose of This Study

No extensive soil bacteriological study of the soils of Michigan has been made. This report presents the results of an investigation concerning the non-symbiotic nitrogen-fixing soil organisms in some of the more extensive soil types in the State. The idea was conceived that perhaps the Clostridium group (anaerobic) is more important in Michigan soils than is the Azotobacter group (aerobic) since 70 per cent or more of the soils in the State are acid and since the Clostridium group is more acid tolerant than is the Azotobacter group. Understanding the former group to be more acid tolerant, it seems reasonable to expect it to be of much more importance than Azotobacter which has an acid pH limit of about 6, as found by numerous investigators. The majority of Michigan soils fall below this pH value. In this investigation, therefore, attention is given to the non-symbiotic nitrogen fixing organisms.

The general outline of the experimental work may be indicated as follows:

I Non-symbiotic nitrogen fixation
  A Soil tumbler method
  B Solution Method
  C Soil plate method
II Bacteriological analyses
  A Plate counts
  B Identification of bacteriological groups and species

The results secured by these various methods should give an indication as to the number of nitrogen-fixing organisms or to their intensity of action as evidenced by their ability to fix nitrogen under favorable conditions. Furthermore, one should be able to ascertain which group (aerobic or anaerobic) is most active and of greater importance.

The soil types used in this study are: Miami loam, Hillsdale sandy loam, Fox sandy loam, Berrien loamy sand, Brookston loam, and Napanee clay loam. The Miami, Brookston, and Napanee are representatives of the heavy soils and the Hillsdale, Fox, and Berrien of the light soils in the State.

Experimental Work and Results

The results herein reported should be regarded largely as preliminary. The conclusions to be drawn from the results obtained by the three methods (soil tumbler, solution, and soil plate), relative to the amounts of nitrogen

fixed, are essentially the same, although, as was expected, the amounts of nitrogen fixed varied with the different methods. Hence this discussion is limited almost entirely to the soil tumbler method of determining non-symbiotic nitrogen fixation.

Fresh soils equivalent to 100 grams oven-dry soil plus the treatment indicated in Table 1 were placed in tumblers. The soils were made up to 50 per cent of their water-holding capacity and so maintained throughout the experiment. The following determinations were made on the soils in the tumblers at the beginning of the experiment, at the end of six weeks, and at the end of 12 weeks: (1) pH, (2) nitrate nitrogen, (3) total nitrogen, (4) total carbon, and (5) available phosphorus.

The results of the study by the soil tumbler method are presented in Table 1.

The results in Table 1 show that there was definite fixation of nitrogen in all of the six soil types variously treated, except, in a few instances, where straw was added as the source of energy for the nitrogen-fixing organisms. In every instance, the amount of nitrogen fixed in the soil receiving no treatment was greater than the corresponding soil to which straw had been added. Alfalfa incorporated with the soils seemed to serve as a better source of energy than any of the other materials used. Mannite was next to alfalfa in order of its effectiveness on nitrogen fixation. Phosphorus and potash greatly stimulated nitrogen fixation especially when lime was also applied. The amount of nitrogen fixed was greatly increased by the addition of lime on those soils which had a rather high degree of acidity. The effect of lime on the Brookston soil was not very great due to the fact that it is naturally well supplied with lime. The Hillsdale soil while normally acid had received a liberal application of lime about three years previous to sampling and for that reason did not give a marked response to the additional lime treatment.

The Brookston loam possesses the greatest natural nitrogen-fixing ability of the soils studied, and the Napanee clay loam was usually next in order. Appreciable amounts of nitrogen were fixed by all soil types studied. The amounts fixed by the Berrien and Fox soils, upon the addition of an energy supplying material along with lime, phosphorus, and potassium are especially remarkable.

From the data in Table 1, it is impossible to draw conclusions regarding the type (aerobic or anaerobic) of fixation. During the course of this experiment, the soil conditions were kept as nearly ideal for crop growth as possible and the conditions might appear to be purely aerobic. In reality, however, these soil conditions may afford a very favorable environment for the anaerobic organisms, since it is quite conceivable that a soil under the most favorable conditions for crop growth may supply a considerable amount of anaerobic space within and about the structural framework of the soil.

Acidity determinations would indicate Azotobacter (aerobic group) to be inactive in the Berrien, Fox, and perhaps in the Miami, since these soils fall below pH 6, which is the lower pH limit for this group of organisms. Azotobacter colony counts were made on each soil type. The average number of colonies per gram of soil that developed on agar plates* were as follows: Miami, 5; Brookston, 213; Berrien, 0; Hillsdale, 54; Napanee, 7; Fox, 0. (These values represent the average count made on five plates.)

The development of Azotobacter colonies is shown in Figure 1. In this

*An adaptation of the Winogradsky silica gel plate after Curie. Soil Sci. 32; 9-25. 1931.

Table 1.—Milligrams of nitrogen fixed per 100 grams dry soil in 12 weeks (Soil Tumbler Method.)

Soil Type	No Lime						Lime(d)					
	No Treat-ment	Straw 2%	Alfalfa 2%	Mannite 2%	Mannite(a) +P(b)	Mannite(a) +P(b) +K(c)	No Treat-ment	Straw 2%	Alfalfa 2%	Mannite 2%	Mannite(a) +P(b)	Mannite(a) +P(b) +K(c)
Miami loam	.4	−6.2	23.4	7.1	6.5	9 2	4.9	−9.9	31.8	13.7	16.7	16.9
Brookston loam	23.5	10.7	80.5	22.9	36.3	39.2	22.0	9.7	88.7	20.2	38.2	39.9
Berrien loamy sand	1.9	− .9	37.6	10.0	10.5	6.2	12.3	2.0	41.6	11.0	25.5	25.8
Hillsdale sandy loam	8.1	3.0	33.3	14.8	16.5	25 5	8.5	2.3	25.8	14.1	24.5	34.8
Napanee clay loam	12.7	−2.3	50.2	13.5	14.5	15 2	17.9	−2.3	53.4	15.9	25.3	29.5
Fox sandy loam	8.5	3.2	8.8	8.6	9 2	13.5	13.3	7.7	25 2	22.8	25.9	27.5

(a) 2% Mannite added.
(b) Phosphorus applied at the rate of 400 lbs. $Ca_2H_2(PO_4)_2$ per acre.
(c) Potassium applied at the rate of 200 lbs. KCl per acre.
(d) Lime applied at the rate of 3 tons $CaCO_3$ per acre.

case one gram of Brookston loam soil was used as the inoculum. The Fox sandy loam did not produce Azotobacter colonies as is clearly indicated in Figure 2.

Since no Azotobacter colonies developed on the Fox and Berrien soils under favorable laboratory conditions, it appears justifiable to attribute the fixation noted in Table 1 to the Clostridium, anaerobic organisms, or

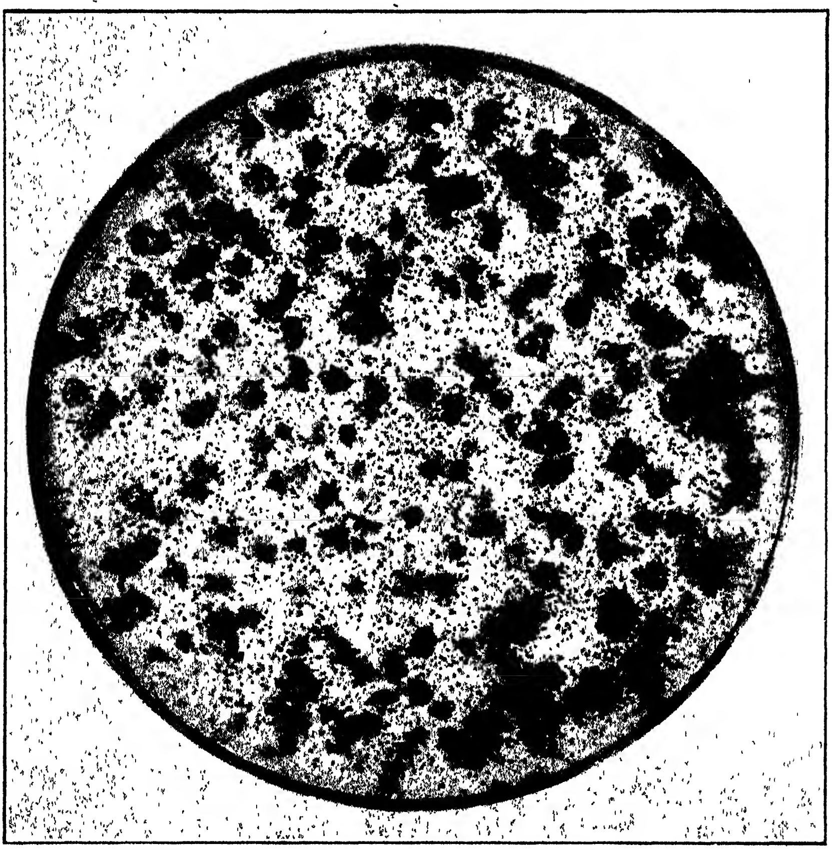


Fig. 1.—A large number of Azotobacter colonies developed on a nutrient medium inoculated with Brookston loam soil.

perhaps to some type of aerobic organism other than Azotobacter. Even at the end of the incubation period of 12 weeks the Fox and Berrien cultures failed to develop Azotobacter colonies in spite of the additions of lime, phosphorus, and potassium.

Discussion of Results

The results which are presented here are by no means conclusive from all standpoints and should be regarded largely as preliminary. The results show definitely that the six soil types used in this study contain a rather

active non-symbiotic nitrogen-fixing flora, since a very definite and, certainly, an appreciable amount of nitrogen fixation occurred. In fact, the amounts fixed are great enough to be of considerable economic importance.

Of course the amounts of nitrogen fixed in the laboratory are much in excess of those that would be fixed under natural soil conditions during the same period of time, because of much more favorable environmental conditions for nitrogen fixing organisms, especially a more favorable temperature and more abundant food supply. The results, however, do show definitely that these soils are capable of fixing nitrogen and in quite appreciable amounts if the environmental conditions are made favorable.

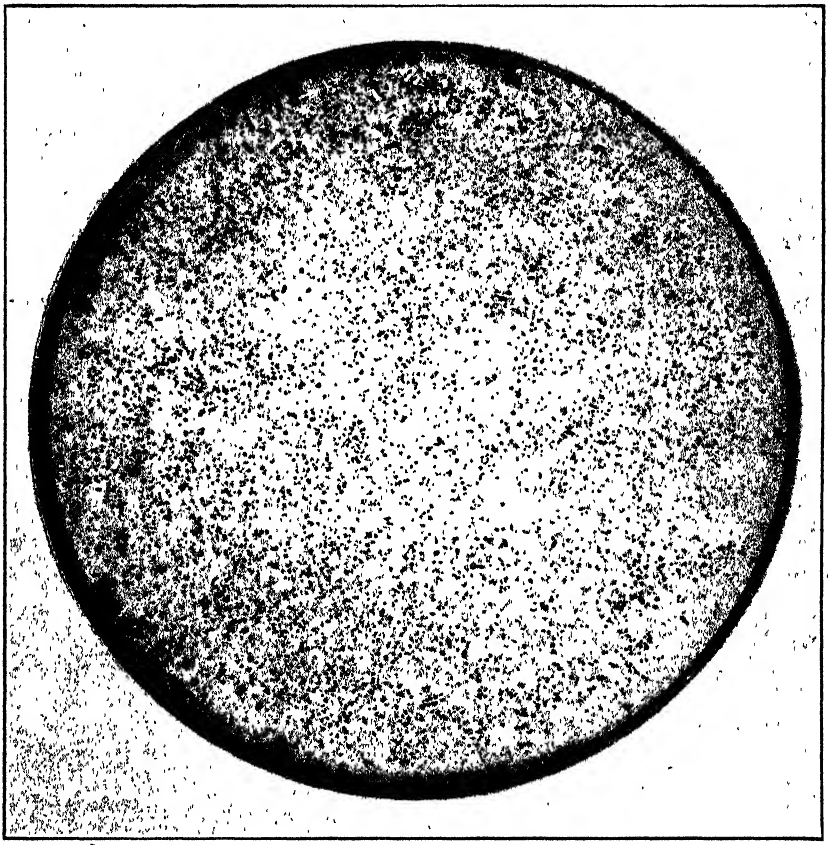


Fig. 2.—No Azotobacter colonies developed on a nutrient medium inoculated with Fox sandy loam soil.

This study is of considerable practical and economic importance. If the farmer can cause his soil to be supplied with 20 to 50 pounds of nitrogen per acre per year, it surely should warrant due consideration. The individual farmers may, by applying lime and fertilizers and returning all crop residues as far as possible, greatly increase the yields of his crops, and at the same time, make the soil conditions favorable for these nitrogen-fixing organisms to obtain nitrogen from the air.

It is next to impossible to determine definitely the amount of nitrogen fixed under natural conditions because of the many variable factors which cannot be accounted for or be controlled. For instance, it is very difficult to determine the amount of nitrogen that may rise to the surface soil from the subsoil, or how much nitrogen may move in seepage waters laterally, how much is leached down through the soil by percolating waters, how much is lost by volatilization through the process of denitrification, or how much is added to the soil through rainfall. In addition, present methods for determining total nitrogen are rather crude and it is impossible to measure small changes in the nitrogen content of soils which may occur. From this brief discussion, it is evident why this experiment is best performed in the laboratory, where more nearly ideal conditions can be secured and so obtain measurable differences in the quantities of nitrogen which may be fixed.

It is impossible to draw definite conclusions regarding the nature (aerobic or anaerobic) of the fixation in these soils from the data presented, but the results indicate that the anaerobic nitrogen fixers are quite active and are of greater importance in adding nitrogen to soils than has generally been supposed.

This study is being continued and special consideration is being given to the anaerobic nitrogen-fixing organisms. It is hoped that through these studies some conclusion can be drawn as to the relative importance of the anaerobic and aerobic nitrogen-fixers in the soils of Michigan. The results of this investigation will be presented in more detail in a later publication.

Summary

A preliminary report is given showing that the soils of Michigan (six types used in this study) contain a rather active non-symbiotic nitrogen-fixing flora.

The Brookston soil possesses the highest nitrogen-fixing capacity of those studied.

Results are presented showing that nitrogen fixation is greatly increased upon the addition of fresh organic matter (especially legumes), lime, phosphorus, and potassium; either alone or in combination.

The addition of alfalfa greatly stimulated nitrogen fixation in the soils studied, especially when supplemented with lime in the case the soil was very strongly acid.

Possible practical applications for the foregoing results emphasize the necessity for consideration of the nitrogen-fixing organisms in a good system of soil management.

The results secured also emphasize the need of a more thorough study of the importance of non-symbiotic nitrogen fixation in field soils in Michigan.

THE MUSLIN TUBE FRUIT JUICE FILTER

The Home-made Filter Permits Production of Brilliantly Clear Apple Cider at Low Cost

R. B. HICKOK AND ROY E. MARSHALL, SECTIONS OF AGRICULTURAL ENGINEERING AND HORTICULTURE

Following the development of a practical method for producing a brilliantly clear and transparent apple cider by the New York Agricultural Experiment Station,* the Michigan Station showed that consumer demand may be very substantially increased by offering the public this cider rather than the ordinary cloudy, opaque product at price differentials of five to ten cents per gallon.† Records of sales at the Michigan State College during the fall of 1932 fully duplicated those of the previous season. There were very few calls for the untreated cider, though it was always available at five cents per gallons less at the College and 10 to 12 cents per gallon less at the Lansing City Market.

Fruit growers have realized the advantages of producing a clear, readily salable product but were unable in most cases to install the facilities necessary for producing such a product because of the cost of commercially manufactured filtering equipment. It was evident that some means of avoiding this initial cost for equipment must be devised before the average fruit grower could become interested in both clarification and filtration of cider. The problem of devising some means of providing a practical filter that could be built by the average farmer, including specifications that must be complied with in handling cider, was worked out along the following lines by the senior author. The subsequent development of an inexpensive, simple, and effective filter which can be constructed easily by any farmer removes the barrier to home preparation of attractive and readily salable fruit juices.

The Home-made Filter

The set-up for performing the filtering operation consists of three principal parts:

1. A mixing and supply tank.
2. Elevation of the supply tank to provide a pressure head on filter unit.
3. The collecting or filtering unit.

The collecting unit is the novel and most essential part of the outfit. It is a long, slender, cloth tube, closed at one end, with the other end connected to a rubber hose extending from the supply tank. This tube is laid in a horizontal position in a trough. When the mixture of cider and filter aid is fed into the closed tube, the pressure swells the tube to its full dimensions. The cider is forced out rather uniformly over the entire surface of the tube and the filter aid forms a cake of uniform thickness on the inside. The

*Kertesz, Z. I. "A New Method for Enzymic Clarification of Unfermented Apple Juice." N. Y. Agr. Exp. Sta. Bul. No. 589. 1930.

†Marshall, Roy E. "Clarifying Cider Increases Demands from Consumers." Mich. Agr. Exp. Sta. Quart. Bul., Vol. XIV, No. 3. 1932.

trough is given a slight slope so that the clear juice runs out of one end into a receptacle.

The cloth tube is made of unbleached muslin, sewed to give a diameter of approximately three inches. A tube of a larger diameter will not support the filter cake satisfactorily and subsequent cracking and breaking of the cake may cause cloudiness in the filtered cider. A tube one yard long is most convenient. It cleans easily, coats evenly in a short time, and is the usual cloth width sold. It is recommended that both ends of the tube be left open to facilitate cleaning. In use, the dead end should be folded back, carefully gathered and tied, preferably with a single miller's knot.

The tube should be supported in the trough by a copper screen. This allows free flow from the trough and makes the entire area of the tube effective in filtering. The copper screen is preferable to iron wire screen because it is less affected by fruit juices.

It is necessary to have a small pressure head on the filter. This can be satisfactorily secured by elevating the supply tank. The greater the elevation the more rapid the flow will be from the filter. The net head should not exceed 15 feet (with muslin tube) and eight feet results in very satisfactory operation. Less head may be used where small quantities are to be filtered, but will necessitate more frequent cleaning of the collector. Tests with cider subjected to enzymic clarification gave the following rates of filtration:

Net Head (Ft.)	Gallons Per Minute*
4	.65
6	1.05
8	1.43
10	1.80
12	2.50
14	3.34

The necessary head may be obtained in different ways: 1. The supply tank may be put on the floor of the upper story of a building and the filter below; 2, a platform may be constructed to support the supply tank at the desired height; 3, or the tank may be raised and lowered by a block and tackle or chain fall. Where a large amount of filtering is to be done, it may be more economical to use a pump† in connection with a storage tank. A pump may be directly connected to the filter, in which case it should be provided with a pressure control. For farm purposes, the cider can be carried or hand-pumped to the height of the supply tank.

The supply and mixing tank should be of wood. A barrel, with the head removed for filling and mixing, may be used where small quantities of cider are handled. Delivery to the filter should be through a rubber garden hose, preferably five-eights inches in diameter. The tank may be bored and fitted with a brass spigot, or the cider may be siphoned from the barrel. It is convenient to have a cut-off in the delivery hose. A convenient arrangement is a ½-inch gate valve at the lower end, fitted with two nipples. One ⅜-inch nipple with bushing will fit into the inside of the hose and the filter tube can be attached to the other. This arrangement is convenient for shutting off the flow to clean the unit and for starting the siphon. The muslin tube should be wrapped tightly around the nipple and tied with a miller's knot.

*These were for short runs of about five gallons and rate would be lower for longer runs with thicker filter cakes.

†Where a pump is used, it should be of bronze and with a minimum of metal in contact with the cider.

Clarification of Cider

Clarification of cider is accomplished by the so-called pectinol enzymic process (see citation by junior author in footnote of first page). This method is comparatively inexpensive, requires no additional equipment, and produces very satisfactory results.

Fig. 1.—Gallon glass jugs are satisfactory containers for the merchandizing of cider. The cider on the left was strained twice through two thicknesses of cheese cloth without previous clarification. That on the right was subjected to enzymic clarification followed by filtration. Note that the unfiltered product is opaque while that which was filtered is clear enough so that the figures on the calendar behind it are clearly visible.

Pectinol, as manufactured by the Röhm & Haas Company of Bristol and Philadelphia, Pennsylvania, is a powder which may be added directly to the freshly expressed juice. Its principal action is to break down the pectin substances in the juice, thereby producing a sediment which is easily removed by filtration or even to a considerable extent by siphoning. To get the active agent of the Pectinol into solution, place the required amount in a gallon glass jug and fill the jug to about three-fourths or more of its volume with warm water or cider (about 100° F.) and shake well at intervals for about 20 minutes. This mixture may then be strained through a double thickness

of cheese cloth into the freshly expressed barrel or tank of cider and the residue discarded.

Pectinol, like other enzymic preparations, requires time to complete its work or to complete the chemical reaction in the cider. The rate at which the reaction takes place also depends on the temperature of the cider. The Table 1, supplied by the manufacturer, suggests the quantities (in ounces) that should be used for each 100 gallons of cider for different temperatures and different periods of time.

These rates are essentially the same as those used at Michigan State

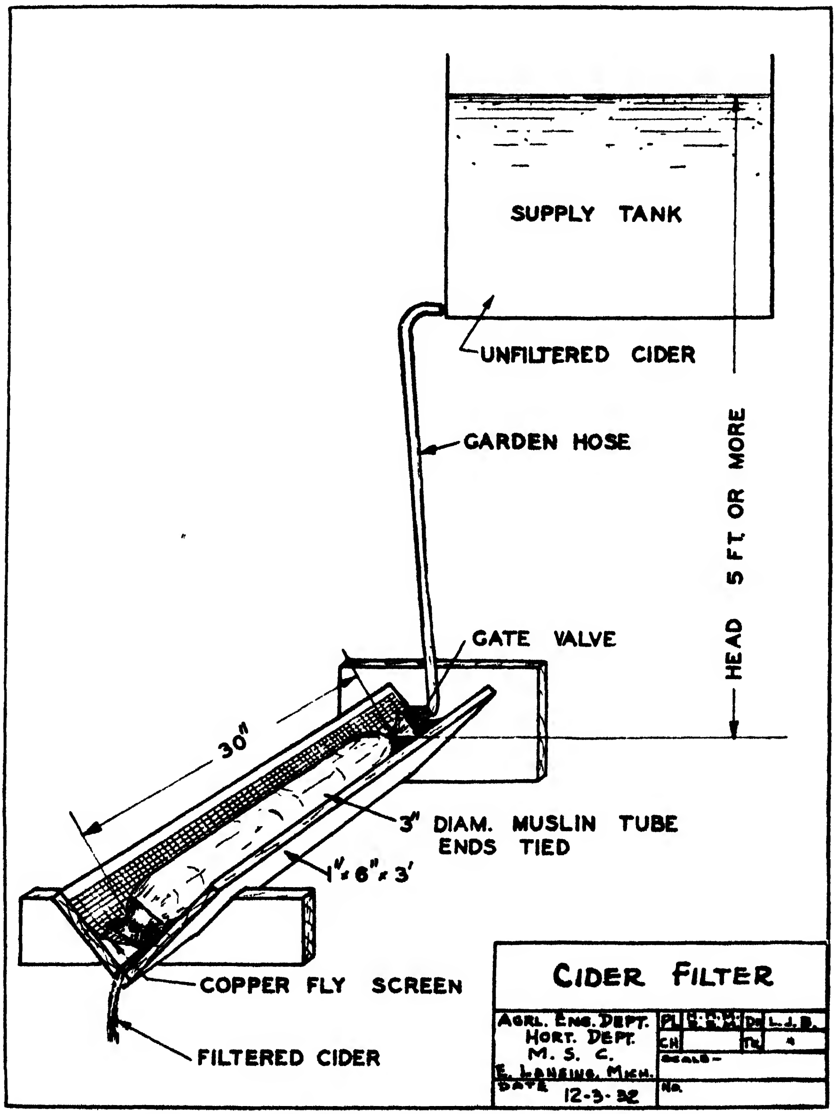


Fig. 2.—The essential units of the home-made filter.

Table 1.—Time allowed for action of Pectinol.

Temperature	5 hours	15 hours	30 hours	48 hours
40°.. . . .	.	30	15	10
60°..	54	18	9	6
100°.	14	5	......	. . . ..

College during the past two seasons. The usual practice at the College is to grind the apples and express the juice during the afternoon. The enzyme is usually added to the cider during the latter part of the afternoon, the cider placed in cold storage over night and filtered the following forenoon after some 15 to 16 hours have elapsed. Twelve ounces of Pectinol to a 50-gallon barrel usually gives good results under these conditions.

Filters are designed to make use of a "filter aid" which is thoroughly mixed with the fruit juice. These filter aids are usually diatomaceous or infusoral earths of varying porosities which build up cakes on a supporting medium, such as a cloth of proper density, through which the fruit juice is forced under pressure. As the juice passes through this porous filter cake, the broken down colloidal matter and sediment are collected while the clear juice passes through. A filter aid known as Hyflo, manufactured by the Johns-Manville Company of Cleveland (branch in Detroit), has given very satisfactory results in numerous tests at the college.

The amount of Hyflo to use varies considerably with the varieties of apples used in making the cider, with the maturity of the apples, and with the clarification treatment. For most conditions, the best results are obtained by using about one pound to 30 gallons of cider. When the clarification is not as complete, or when the cider is made of very ripe apples, the proportions may be increased to one pound to 20 gallons. When clarification is exceptionally good, as little as one pound of Hyflo to 40 gallons may suffice.

The Hyflo must be thoroughly mixed with the cider and it may be necessary to agitate the mixture from time to time. Where large quantities of cider are made, a motor driven agitator may be installed for the supply tank.

It is necessary to let some cider (about two gallons) run through the unit before collecting any for use, in order to build up a filter cake in the tube. As the filter is used, the filter cake gradually becomes clogged with material removed from the cider and the rate of flow is reduced. The rapidity of clogging depends largely upon the amounts of "Hyflo" used, the amount of suspended matter and sediment in the cider, and the extent to which clarification has taken place. The filter cake should be a solid, porous, light chocolate-brown mass. If there is not enough Hyflo, the cake will be dense, dark, and slimy.

With small pressure head (six to eight feet net), the tube must be cleaned about every 20 to 40 gallons. With more head this may be extended considerably. Since the longer the cake has been building up, the more sparkle will be noticed in the filtered juice, it is advisable to run as long as possible. Cleaning is very simple. The tube is untied and may be shaken out and rinsed, but, where running water is available, the tube can be held over the end of the tap and quickly flushed out. Only a few minutes are required to take off, clean, and replace the unit.

Where a large quantity of cider is to be run, a high rate of flow can be

obtained by assembling a battery of the specified units. All may empty into a single header trough if arrangement is made to prevent the mixing after a unit has just been cleaned and if the cake has not had time to build up again.

This discussion has been limited to the processing of cider, but with some modifications, this method of filtering has a widespread use. It can be made to work with the other fruit juices, vinegar, and other home products.

Directions For Clarifying and Filtering Cider

1. Add Pectinol RA (obtained from Rohm & Haas Co., Bristol, Pa.) to freshly expressed cider at rate of 20 to 30 ounces per 100 gallons. The Pectinol powder should be placed in a jug with warm cider or water (about

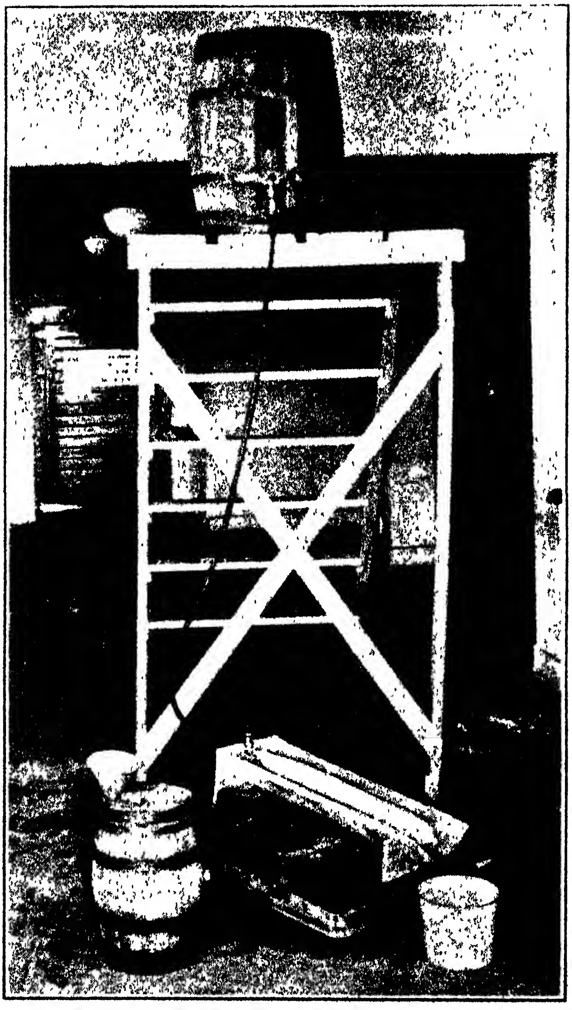


Fig. 3.—Tests with the home-made filter, were conducted with this set-up in a college laboratory.

100° F.), agitated at intervals for 20 minutes, and strained through cheese cloth into a barrel or vat of cider. The residue after straining should be discarded.

2. Allow about 15 hours for Pectinol to do its work (the breaking down and sedimentation of colloidal substances), when the cider will be ready for filtration.

3. Place cider in the mixing or supply tank for filtration. Thoroughly mix Hyflo filter aid (obtained from Johns-Manville Co., Detroit) into cider at rate of two to four pounds per 100 gallons. Allow cider to run through filter aid until clear (first few gallons will contain some suspended filter aid and must be refiltered). If cider fails to clear up, look for a leak in the system.

GOOD POULTRY EQUIPMENT—ONE OF THE SHORT CUTS TO GREATER POULTRY PROFITS

J. M. MOORE, SECTION OF POULTRY HUSBANDRY

There are many types of poultry equipment on the market today If one wishes to, he can equip his poultry farm in a very elaborate manner or he can make his flock comfortable with home-made equipment which to a hen, at least, is just as satisfactory and she will respond with a profitable egg production, providing she has been properly reared.

In rearing pullets, an outdoor mash hopper is necessary. This hopper

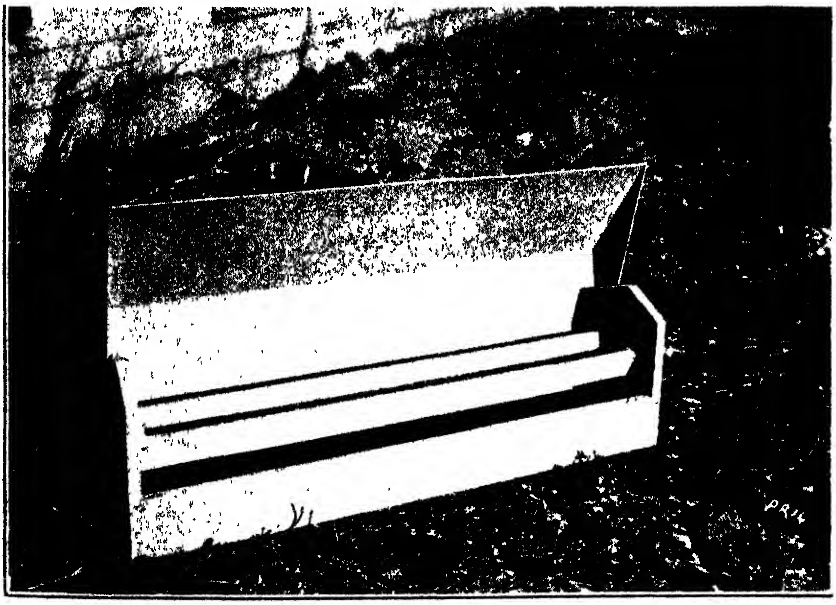


Fig. 1.—The Outdoor Mash Hopper shown with the cover thrown back ready for filling it with mash.

should carry sufficient feed for at least three days. The practice of using a mash hopper which is filled only every three or four weeks is not satisfactory. The writer has seen moldy, wormy feed in such hoppers. If it had been necessary to refill such a hopper twice a week, the attendant would have noted the conditions and rectified them. There is evidence to indicate that chickens as well as humans prefer fresh food. Fresh feed supplied twice weekly adds an incentive for increased consumption and therefore better growth.

The accompanying Figs. 1, 2, and 3, show the outdoor mash hopper which can be used for chicks from six weeks of age until they are old enough to be put in the laying house. This hopper is four feet long. The bottom and top are composed of one piece of 24 gage galvanized iron. As galvanized sheet metal may be obtained in 4-ft. x 8-ft. dimensions, one sheet will make the metal work for two hoppers. The ends are composed of one inch cypress,

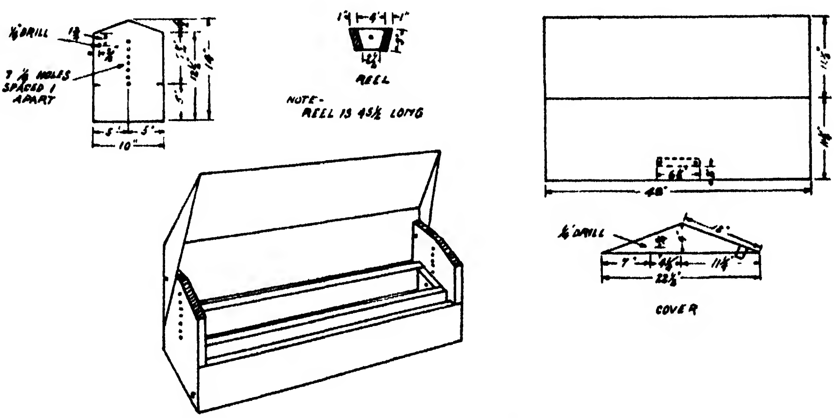


Fig. 2.—Plans for the Outdoor Mash Hopper.

white pine, or basswood. As the ends support the top and bottom, the lumber used in making them should be at least one full inch thick. The sides of the hopper have an inch lip to prevent the wasting of feed. The reel of the hopper resembles a V in shape with the bottom of the V cut off. Because of its shape, it is of assistance in pouring in new feed and acts as a funnel in directing the feed into the hopper. The reel is adjustable and can be either raised or lowered as desired. The top of the hopper is attached to the ends by two bolts ¼-inch x 1½ inches long. These bolts act as a hinge so that the hopper may be easily opened to be filled.

If one wishes, the whole hopper may be constructed of lumber. Under such circumstances, it would be advisable to make the hopper five feet long instead of four feet. However, it has been the writer's observation at the experimental poultry plant that lumber hoppers do not stand up as well as the metal ones. Metal hoppers are slightly more economical to build when a good grade of lumber is used. However, every one must use what proves to be the cheapest and the most readily available. This hopper when full will hold from 40 to 50 pounds of feed.

The open type mash hopper is used in the laying house. The hopper shown in Figure 4 is four feet long, this being the most economical size to

use when made of galvanized iron as two hoppers can be made from one sheet four feet long and four feet wide. When lumber is used the length can profitably be increased to five and even six feet.

The legs and walk boards are nailed to the ends which should be made of one full inch cypress, pine or basswood to be strong enough to stand the

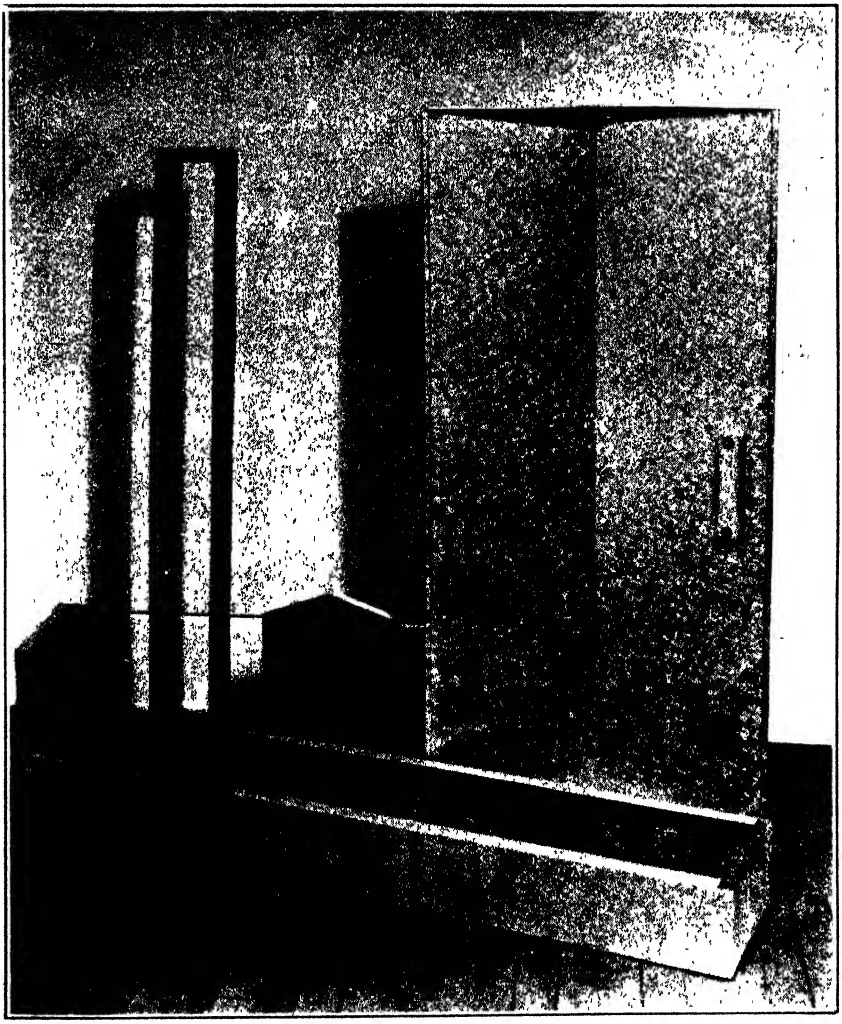


Fig. 3.—The construction of the Outdoor Mash Hopper.

strain. The legs and walk boards may be made from ⅞-in. material. The reel is made of 1-in. x 4-in. material; a nail driven in each end of it makes the needed axis by revolving in a groove 3/16-in. wide and ½-in. deep cut in each end of the hopper. This hopper when full will hold 35 pounds of mash. When new mash is added, the old mash should be collected at one

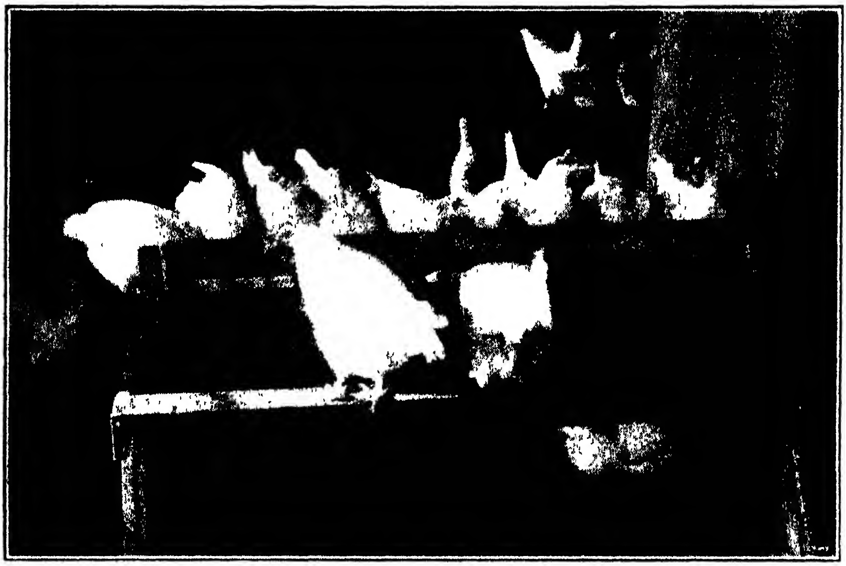


Fig. 4.—The Laying Mash Hopper in use. This hopper should accommodate 50 birds when scratch grain is fed in addition to mash.

end before pouring in the new mash. In this way, the old mash is changed and does not become too stale.

There are many different types of poultry waterers. A good water fountain should embody the following features:

1. Economical in cost.
2. Easily kept clean.
3. One that will allow at least 5 per cent of the birds in the pen to drink at the same time.

The fountain shown in Fig. 7 is a crockery jar 5-in. in depth and 15-in. in diameter. A refrigerator pan of similar dimensions may be used. Either

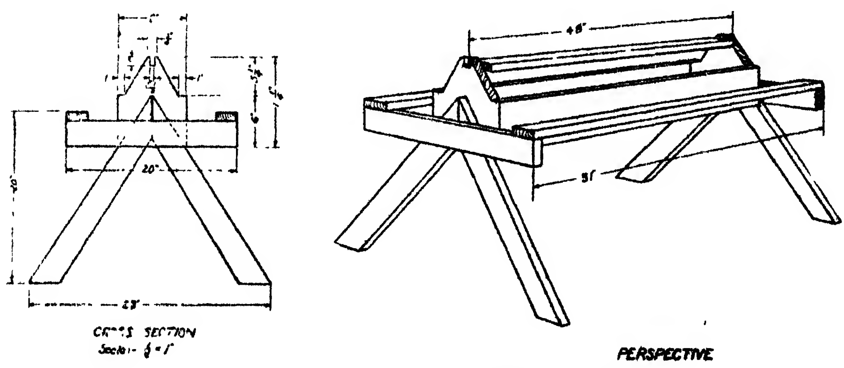


Fig. 5.—Plans for the Laying Mash Hopper.

of these receptacles contain sufficient water for 100 birds. They are easy to clean and not expensive. The water fountain rests on a water stand 16 inches in height. A galvanized metal box is placed inside the stand just below the fountain. A 50-watt bulb placed in this box gives the necessary heat to prevent the water from freezing. If it is desired, the bulb can be replaced by an electric element. Such an arrangement has been successful in preventing water from freezing at East Lansing.

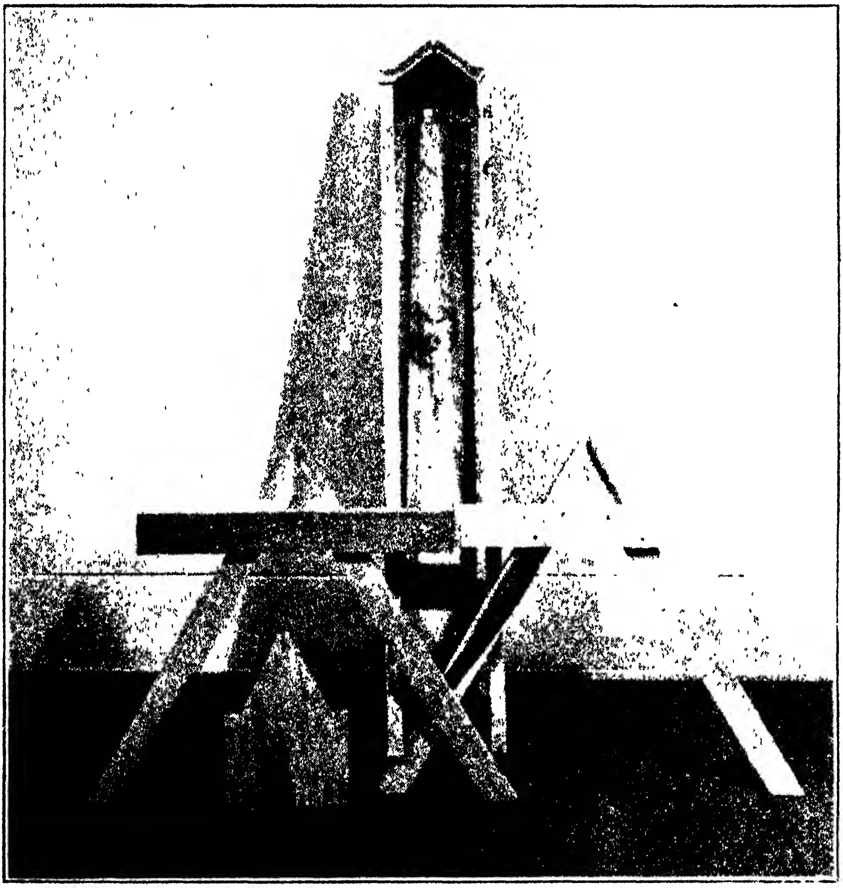


Fig. 6.—The construction of the Laying Mash Hopper.

During the months of June, July, and August, both the growing and laying stock feel the need of shade very keenly. If one drives his car out to a range on a hot day and allows it to stand for a short time, he will find that the growing pullets will immediately gather together underneath it for shade if they have no other near by. The poultryman can plant crops that will furnish shade, such as sweet clover, artichokes, corn, or sunflowers. However, in many cases, such a crop is not possible and the "Summer Shade" shown in Fig. 9 is recommended.

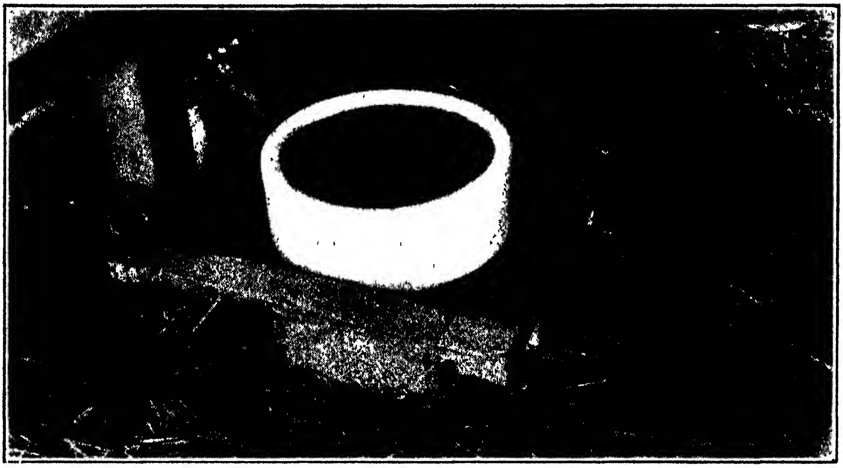


Fig. 7.—The water fountain, water stand, and water heater in operation.

This summer shade is made in two sections which are hinged together. Each section is a frame of 1-in. x 2-in. material which is 3 feet 9 inches wide and 10 feet long and covered with used feed sacks. These feed sacks are ripped open along the seam and tacked over the frames. The two sections may be closed up tight when storing them away for the winter so they will take up the least possible space. In the summer, they are brought out and spread apart the required distance. The edges are then nailed to two cross-pieces which keep the shade fourteen inches off the ground. The cross-

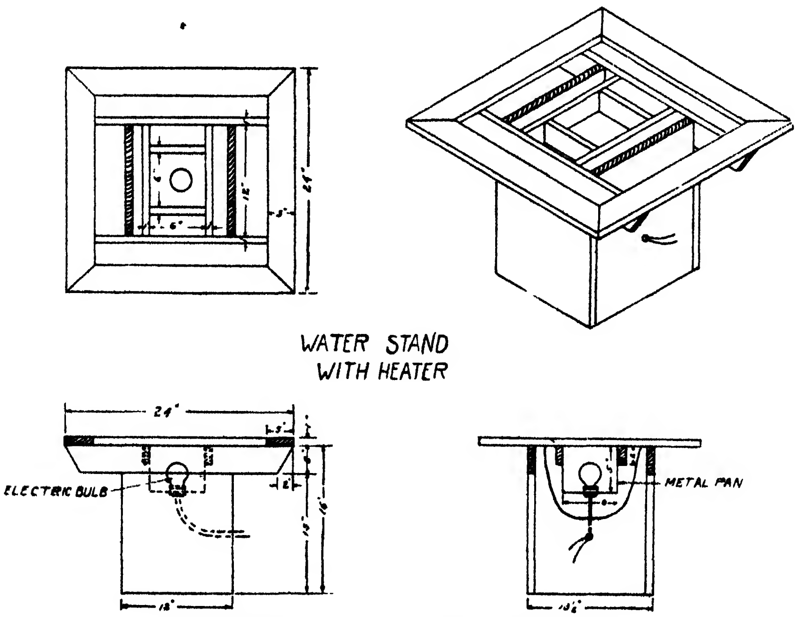


Fig. 8.—Plan for Water Stand and Heater.

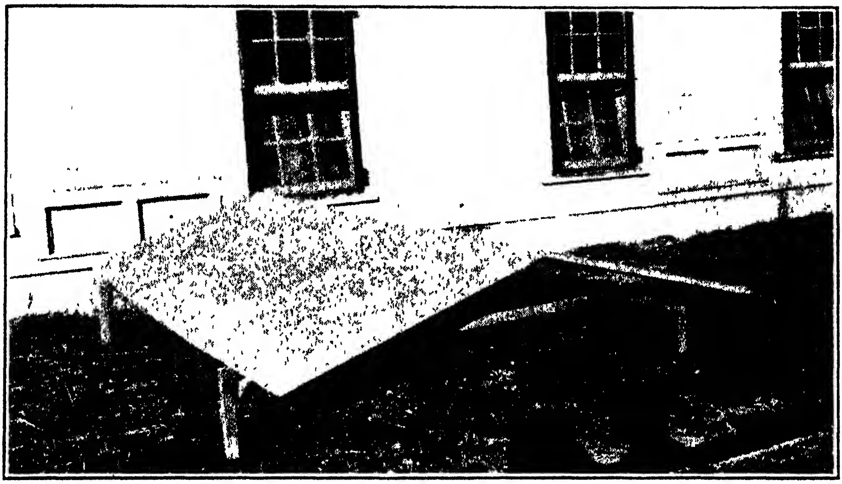


Fig. 9.—Showing construction of summer shade for poultry.

pieces are made of 2-in. x 2-in. yellow pine to which the legs are attached. This summer shade is sufficient for 50 pullets and where there is no natural shade this will prove to be a very desirable piece of poultry equipment either for the pullet or laying flock.

Any poultry keeper must be able to catch the birds in his flock quickly and quietly. If the birds are in production, their egg production may be

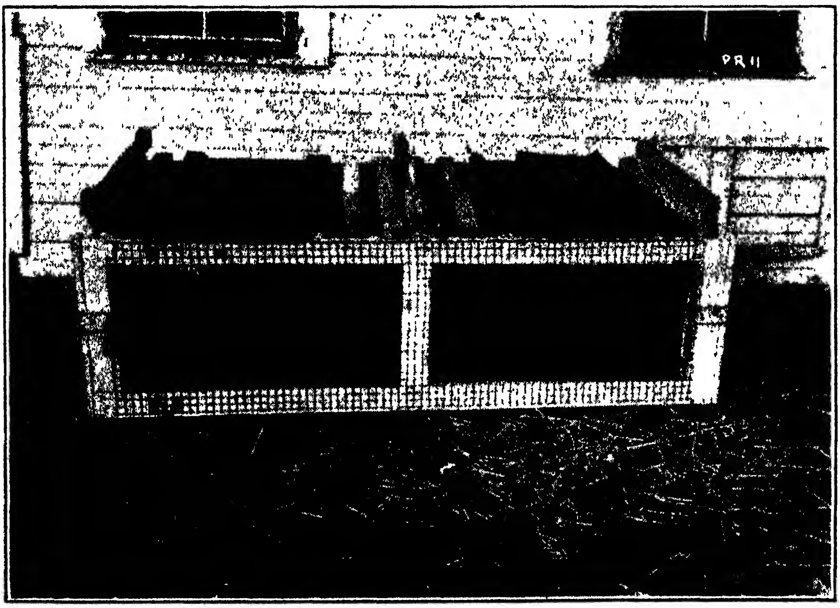


Fig. 10.—The catching crate, showing the movable ends and middle partition and the cover which is made from automobile inner tubing.

much impaired if they are frightened during the operation. It is therefore advisable to confine the birds by a method in which they will be disturbed as little as possible. Fig. 10 shows one section of the catching crate ready for use. The top consists of pieces of automobile inner tubing lapped over each other and stretched in place. This makes a cover through which the birds may be taken out without injury but one which is never left open to allow the birds to escape. The catching crate is 31 inches wide, 19½ inches high, and 5½ feet long.

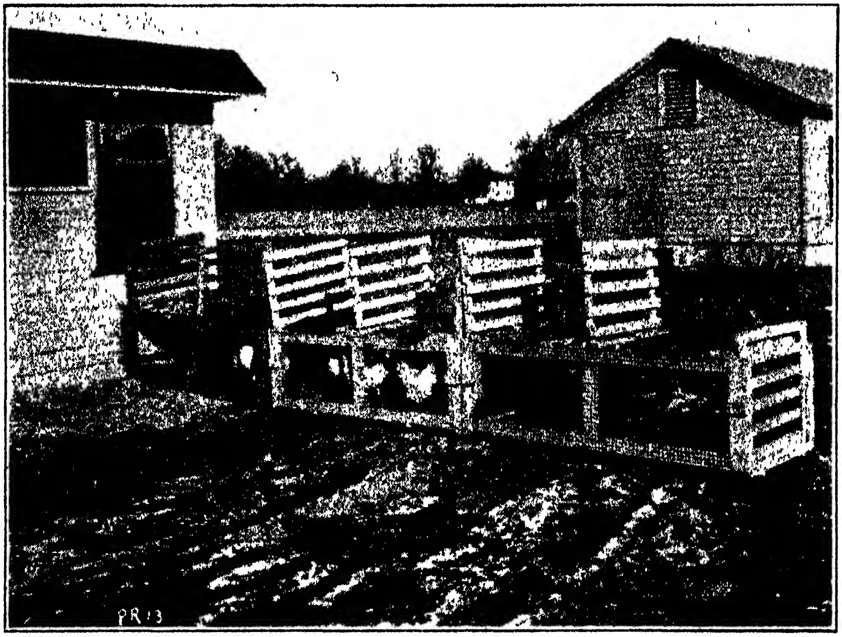


Fig. 11.—Three catching crates with partitions raised and the birds being driven from the house into them. When many birds are being handled the extra crates are a great time saver.

Figure 11 shows three sections of these catching crates in use. Every three feet there is a partition to prevent the birds from piling up over one another. These partitions are all raised and the birds driven out of the house into the crates. When the compartment farthest from the house is filled that partition is dropped in place and so on until each one is filled. If the poultryman wishes, each crate can be lifted into a wagon or truck and taken away or the handling of the birds may go on where they have been caught. Seventy-five birds can be caught at one time by the use of three sections.

BULLETIN REVIEWS

Circular Bulletin 145.—"Field Peas for the Upper Peninsula of Michigan."—Churchill, B. R.—This bulletin includes a discussion of field peas as a grain and forage feed for livestock and as grain for human consumption. Descriptions of varieties adapted to the region are given together with detailed information on time, rate and method of seeding, time of cutting, and method of curing and threshing. Notes are included on disease and insect pests with emphasis on the pea moth, an insect well established in certain areas of the Upper Peninsula. (12 pages, 3 figures.)

Special Bulletin 227.—"Motor Truck Marketing of Michigan Fruits and Vegetables." Motts, G. N. The purpose of this bulletin is to describe the scale of truck movements, the groups engaged, the operating methods employed, the advantages responsible for its development, and the disadvantages to be overcome if possible. The changes in motor truck marketing of fruit and vegetables suggested by representatives of the different marketing groups are presented and certain recommendations for growers, shippers, truckers, jobbers, retailers, and consumers are made. (47 pages, 3 figures, 24 tables.)

Technical Bulletin 125.—"Further Observations and Experiments With Mosaic Diseases of Raspberries, Blackberries, and Dewberries." Bennett, C. W.—Two types of Mosaic, yellow and red, occurring upon raspberries in Michigan are described, with experiments showing that the aphid *Amphorophora rubi* is the most common vector on varieties such as Latham and King susceptible to colonization of the insect. It is suggested that strains of the mosaic virus may account for the wide range in symptoms produced under similar environmental conditions. (32 pages, 6 figures, 9 tables).

Technical Bulletin 126.—"Experimental Work on Cucumber Fermentation."—Fabian, F. W., Bryan, C. S. and Etchells, J. L.—Detailed data are presented on the following subjects: (1) The influence of sodium chloride on the biochemical and bacterial activity in cucumber fermentation. (2) Influence of acids, bases and salts on cucumber fermentation. (3) The influence of some environmental factors. (4) Morphological studies on spoiled cucumber pickles. (5) Studies on cucumber pickle blackening. (60 pages, 8 figures, 14 tables.)

JOURNAL ARTICLE ABSTRACTS

"The Spoilage of Dressed Ducks by Sliminess."—Mallmann, W. L.—Jour. Agr. Res. 44(12):913-918. 1932. (Journal Article No. 86 (n.s.) from the Michigan Agricultural Experiment Station).—When squab ducklings are shipped in crushed ice or ice water very little spoilage results, but when they are shipped moist in containers which permit them to come in contact with the air they become slippery, particularly beneath the wings. Accompanying the slime formation is a markedly offensive odor. Slipperi-

ness will develop in from one to two days, even when the carcasses are kept constantly at ice-box temperature (50° F.). A *Bacillus mesentericus*-like organism with a capsule was isolated from the slimy ducks. The organism was also found in the scalding tank, plumping tank, chilling tank, ice water tank, dressing tables, floor, feet of live ducks entering the plant and on the shelves of the ice chest. Dressing ducks in a clean plant delayed materially the occurrence of sliminess. Storing the ducks in ice water containing 100 p.p.m. available chlorine for 24 hours, followed by immersion in 10 per cent salt solution, stopped the formation of slime.

"A Study of Several Factors in the Separation of Serum from Bottled Cream."—Trout, G. M., and McCan, J. C.—Jour. Agr. Res. 45 (8): 483-500. 1932. (Journal Article No. 87(n.s.) from the Michigan Agricultural Experiment Station.)—Studies were made of 126 lots of cream secured from mixed milk received at the college creamery. The separation of free serum was shown to be a defect of bottled unhomogenized or unadulterated cream. The volume and distinctness of the serum layer were equally important. When the milk was separated at 120° F. the serum layer was less distinct than when separati n was done at any other temperatures. Pasteurizing the milk at 160° F. for 15 minutes reduced the volume of the layer. Standardizing the cream following pasteurization appeared to be desirable in eliminating, in part, the formation of a layer of serum, but had little influence on its distinctness. Bottled cream held in storage longer than 48 hours almost invariably showed an undesirable serum layer. Viscolization at 160° F. and a pressure of 1,500 pounds per square inch was as effective in preventing the formation of a serum layer as 2,500 pounds pressure at 145° F. The addition of small percentages of monocalcium phosphate, dicalcium phosphate, calcium chloride, sodium citrate and sodium carbonate were ineffective in eliminating a distinct serum layer. The addition of 0.3 per cent gelatin to the milk prior to separation prevented the formation of a serum layer in the cream. Similar results were secured by adding 5 per cent evaporated whole milk to the cream. These additions, although in some cases attaining the desired purpose, should be considered as adulterations. Several other factors studied were shown to have little influence on serum separation. Pasteurizing the milk intended for skimming at 160° F. for 15 minutes, separating at 120° F. and standardizing to the desired percentage with pasteurized whole milk yielded a cream in which the smallest serum layer of least distinctness formed.

"A Yeast Extract Medium for the Examination of Milk."—Devereux, E. D.—Amer. Jour. Pub. Health. 22:1291. 1932. (Journal Article No. 96 (n.s.) from the Michigan Agricultural Experiment Station.)—During some recent researches on the isolation of lactobacilli and streptococci from the oral cavity a yeast extract medium was devised. This medium was found to support the growth of many milk organisms, including several which grow very slightly if at all in plain nutrient broth or agar. The formula for the yeast extract broth is as follows: Yeast extract (Difco) 5 gm.; peptonized milk (Difco) 10 gm.; salt 5 gm.; dextrose 10 gm.; water 1,000 cc. Adjust pH to 7.0; autoclave for 15 minutes at 15 pounds pressure. To prepare the agar 15 gm. of washed agar are added to each liter of broth. At the present time several applications are being made of this medium, one using the broth, containing an indicator, for determining keeping quality of milk and one using the agar for determining the bacterial content of milk.

"Effect of Heat at Varying Concentrations of Hydrogen Ion on Vitamin B (B_1) in Protein-Free Milk."—Halliday, N. and Hiller, V. E.—Jour. Biol. Chem. 98 (2):707-717. 1932. (Journal Article No. 106 (n.s.) from the Michigan Agricultural Experiment Station.)—A simultaneous comparative study was made of the stability of vitamin B (B_1) and vitamin G (B_2), the heat-labile and heat-stable members of the vitamin B-complex, using protein-free milk prepared from skim milk powder as the medium, and subjecting aliquot portions to one and four hours of heating at pH 4.3, 7, and 10. In this series of experiments each animal received a small portion of ground whole wheat in addition to the protein-free milk supplement which was being tested for vitamin B (B_1) content.

The following conclusions were drawn from the results obtained in these experiments: (1) The vitamin B appeared to be completely extracted from the skim milk powder into the protein-free milk. (2) Heating one hour at pH 4.3, 7, and 10 caused about 25, 30 and 70-80 per cent loss, respectively. (3)Heating four hours caused 30-40 per cent loss at pH 4.3, 40 per cent at pH 7, and almost complete destruction at pH 10. (4) Holding the solution one week in the cold caused practically no loss at pH 4.3 or pH 7, but nearly complete loss at pH 10. (5) The results in general showed close similarity with those previously reported for vitamin G (B_2)' under the conditions of these experiments. (6) Further evidence is presented of a third factor necessary for the growth of the rat. The basal diet of Chase and Sherman appears to lack this factor and the bodily store of the animals becomes depleted in about 5-6 weeks. Whole red winter wheat is a good source of the vitamin, which is thought to be identical with vitamin B_4, as reported by Reader. (7) Assay of vitamin B (B_1) might well be modified to include a source of this factor.

"Gladiolus Thrips, Taeniothrips gladioli M. & S."—McDaniel, E. I.—Michigan Gladiolus Society, Year Book, August, 1932, pp. 16-17. (Journal Article No. 100 (n. s.) from the Michigan Agricultural Experiment Station.)—This insect is at present (April, 1932) known to occur throughout northeastern U. S. and southeastern Canada and has been reported from Florida. Several native species of thrips are also common on gladioli, the majority of which feed on the pollen of flowers and are comparatively harmless. The gladiolus thrips attack all portions of the plant causing characteristic injury. Many winter on the corms. Breeding is apparently restricted to gladiolus, iris, tiger flower, montbretia and poker plant. The optimum temperature for development seems to be about 80° F. with humidity between 50 and 70 degrees. Where the temperature drops below 50° F. reproduction ceases. The use of a nicotine sulphate 40 per cent spray, 1-800, plus penetrol (at the rate of 1 pint in 100 gallons) was advised for thrips on foliage.

"Carbon Disulphide Emulsion to Control Gladiolus Thrips, Taeniothrips gladioli M. & S."—McDaniel, E. I.—Jour. Econ. Entom. 25 (3): 732. 1932. (Journal Article No. 102 (n.s.) from the Michigan Agricultural Experiment Station.)—In a series of tests to determine a safe, effective method of freeing gladiolus corms of the gladiolus thrips, *T. gladioli,* it was found that severely-infested corms soaked in 50 per cent miscible carbon disulphide emulsion diluted 1-1,000 were rendered free from thrips. The corms were treated for various lengths of time, ranging from 15 minutes to five hours. Other contact insecticides tried at this time were nicotine sulphate 40 per

cent, 1-800 and 1-400 with soap; nicotine sulphate 40 per cent, 1-800, plus penetrol, 1-200; Red Arrow 1-2,000; Yarmor's Pine Oil 1-40 (emulsified with potash castor oil soap); and 50 per cent wormseed oil emulsion 3⅓ cc. to 100 cc. water. The growth of corms soaked with carbon disulphide emulsion was appreciably stimulated when soaked for 30 minutes to two hours. Corms soaked in the nicotine sulphate preparations or in Red Arrow developed normally, but those treated with wormseed oil emulsion and those treated with Yarmor's Pine Oil did not grow.

"The Application of a Yeast Extract Medium to a Test for Determining Quality of Milk."—Devereux, E. D.—Amer. Jour. Pub. Health 22:1292-1294. 1932. (Journal Article No. 120 (n.s) from the Michigan Agricultural Experiment Station.)—In an effort to find a method which would give a reading more nearly representing the actual ability of the bacteria and enzymes present to produce the changes in milk of interest to the producer and consumer, the bromthymol blue milk test or colorimetric hydrogen ion method for determining the keeping quality of milk was devised by Cooledge in 1920. Several optional changes were suggested by Devereux in 1928. The correlation coefficient between the test and the keeping quality was found by Cooledge to be $+ 0.75$. In a comparison of the bromthymol blue test and the methylene blue test Devereux found the coefficient for each test to be $+ 0.77$, which confirmed the work of Ellenberger et al. on the methylene blue test, their coefficient being $+ 0.72 \pm 0.02$. Thus the two tests are comparable as judged from the standpoint of accuracy.

In an effort either to shorten the incubation period or improve the efficiency of the test, or both, a yeast extract medium was substituted for the Cooledge broth. This new medium differed from the Cooledge broth in that dextrose was added, and yeast extract and peptonized milk were substituted for beef extract and peptone. By changing the formula the correlation coefficient between the test and the actual keeping quality of the milk was increased from $+ 0.75$ or $+ 0.77$ to $+ 0.86 \pm 0.02$.

"On the Preparation of Hemolytic and Precipitating Sera."—Stafseth, H. J.—Science. 76:444. 1932. (Journal Article No. 123 (n.s) from the Michigan Agricultural Experiment Station.)—It was found that blood serum is a perfect substitute for red blood cells as antigen in the production of hemolytic sera. This should be of practical value because of greater keeping quality of sterile serum over whole blood or washed blood cells. Rabbits immunized with red blood cells will also yield good precipitating sera. Extracts of washed liver and spleen tissue did not prove satisfactory as antigens in the production of precipitins and hemolysins.

The Bulletins of this Station are sent free when available to such individuals as may request them. Address all applications to the Director, Agricultural Experiment Station, East Lansing, Michigan.

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V. R. GARDNER AND A. J. PATCH

CONTRIBUTIONS BY ALL SECTIONS OF THE
AGRICULTURAL EXPERIMENT STATION

MICHIGAN AGRICULTURAL EXPERIMENT STATION QUARTERLY BULLETIN
Vol. XV, No. 4, May, 1933

PYRETHRUM A SAFE WINTER CONTROL FOR INSECT PESTS OF LIVESTOCK

C. B. DIBBLE, SECTION OF ENTOMOLOGY

The present low price of pyrethrum makes it the least expensive material to use in combating insect pests of livestock. Lice on cattle, sheep, or horses, and ticks on sheep can be killed with it without wetting or greasing the animal. The material is not poisonous to livestock and no danger attends its use. It can be used most economically when diluted with some inert carrier. The cheapest satisfactory formula is given below:

1 pound pyrethrum, freshly-ground flowers
3 pounds flour
Mix together thoroughly

The material may be dusted on the animals with a sifter-can or may be applied with a small dust gun of the puffer type. The lice or ticks should be well exposed to the material by treating all infested areas. Experience in treating many animals shows a few "short-cuts" that will materially aid in the treatment.

Directions for Using Pyrethrum Louse Powders

Examine the animals in a good light and locate the lice.
Treat liberally, one-half pound of powder will treat one cow all over only twice.
Repeat the treatment for lice in 14 days. For ticks on sheep repeat in twenty-one days or less.
Dip sheep and *spray* cattle for control *during warm weather* and *avoid* winter troubles.

The reasons for these simple directions appear in the following discussions of the common parasites for which the treatment is applicable.

Cattle Lice

The small, chewing red louse is most commonly found on the backs of the cattle and can be controlled if the back only is dusted thoroughly. If the large, sucking blue lice are present, the entire animal will have to be treated because they frequent the brisket, neck, chin, belly, back, escutcheon, and sometimes are found about the udder or scrotum. A shaker may be used, but much of the application must be made by rubbing the material into the hair with the hand, treating the top of the head, face, nose, and tail carefully. The small dust gun is more convenient to use and takes slightly less material. About three to four ounces of dust is needed and the application should be repeated in exactly 14 days. If blue lice are present that do not respond to this treatment, 10 per cent powdered naphthalene

or powdered moth balls can be added to the dust. This is sometimes a valuable addition, but is not usually necessary.

Treated animals should stop rubbing and licking in from four to seven days after the first treatment, and no live lice should be found at that time. The black patches of lice noticeable in white hair and on the escutcheon should disappear in about 48 hours.

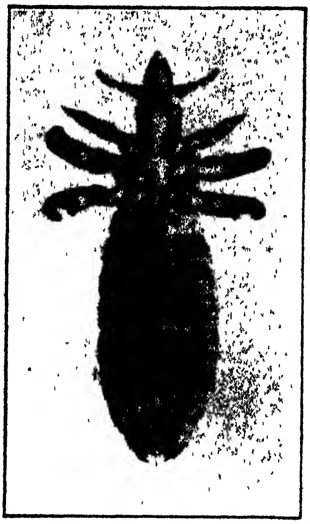

Fig. 1.—Long-nosed cattle louse, (*Linognathus* (*Haematopinus*) *vituli*), greatly enlarged.

Fig. 2.—Short-nosed cattle louse or blue louse, (*Haematopinus eurysternus*), greatly enlarged.

Fig. 3.—Sheep tick, adult and puparium, (*Melophagus ovinus*), greatly enlarged.

Fig. 4.—Little red louse of cattle, (*Trichodectes scalaris*), greatly enlarged.

Horse Lice

Lice on horses are similar to the lice on cattle but are not the same species. The treatment is much the same, but where only a few animals are to be treated, a stronger mixture of the dust is sometimes more satisfactory, since the cost is not prohibitive. For horses mix:

1 pound pyrethrum, with
1 pound flour

This mixture is a strong one and acts quickly. Particular attention should be given the mane, tail, and forelock.

Sheep-Ticks and Lice

Ticks and lice on sheep are readily killed by the mixture suggested for cattle, one pound pyrethrum and three pounds flour. In making the treatment, the sheep may be laid on its side and a shaker-can used to distribute the material. In using the small dust gun, one person holds the sheep in a standing position and another applies the powder. Three to four ounces of powder is required for each animal by either method, but better coverage is obtained by using the blower. It is not necessary to part the wool, as the powder dusted on the outside will work in and kill the parasites if it is evenly and generously applied.

It may be necessary to repeat this treatment, as the "nits" of the lice are not killed and the animals will be infested again later in the season. If lice are numerous, repeat in 14 days, and whenever the ticks appear in numbers, another treatment should be made. One treatment may be sufficient to hold the ticks in check until shearing and dipping time, but it is likely that two will be necessary if the infestation is bad.

Summary

Pyrethrum is not suggested here to replace warm weather methods of parasite control. Sheep and cattle can be freed of lice and ticks most efficiently and cheaply by dipping at the right time. The use of pyrethrum powder is suggested for control during the winter months when other methods are undesirable. Powdered pyrethrum is in no way harmful to livestock and can be used liberally without danger.

TWO LESSER KNOWN PESTS OF PEACHES

RAY HUTSON, SECTION OF ENTOMOLOGY

The abnormal weather of the past few years has disturbed the balance of nature among insects and their allies, as it has among other organisms. As a consequence, some pests which have always been present in small numbers have increased to a point where they or their damages are noticeable.

Green Stink Bug

The adult green stink (soldier) bug, *Acrosternum hilaris,* is, as its name indicates, light-green in color. It belongs to the stink bug family (Pentatomidae). There are several other common bugs which resemble it, but reference to the accompanying illustration will aid in identifying it. The green stink bug is longer in proportion to its length and flatter than most of the bugs with which it might be confused, the adults being five-eighths inch in length, although there is considerable variation in size. The nymphs are brownish-black with yellowish or orange markings and vary in size from one-sixteenth to two-fifths inch in length in the different stages.

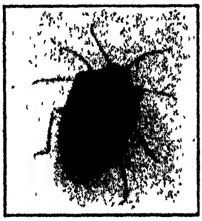

Fig. 1.—Adult Green Soldier Bug.

The adults pass the winter in leaves, weeds, and trash and appear some time during the spring, usually the latter part of May, and subsist on almost any available plant. All stages seem, however, to prefer developing fruit. Fifty eggs are about the average for each female. The eggs are laid in groups upon the leaves of the host-plants and, on hatching, the young bugs remain close together for a few days, then separate.

Fig. 2.—Eggs of Green Soldier Bug.

Injury by the pest is commonly seen during July and August. Damage to peaches is brought about by the reaction of the fruit to the punctures made by the beaks of both the old and immature insects and consists of areas upon the surface of the fruit which at first look watery, then sink somewhat, and finally appear as dull green, unripe areas, among which are islands of normal tissue. The removal of the skin from such areas at harvest-time

reveals a corky area, somewhat like a mild hail injury. Scarred peaches usually occur on trees here and there about the orchard, which seems to indicate that one female bug and her offspring can pretty nearly account for several bushels of fruit.

The only measures that are of any value against this pest consist in the elimination of breeding and overwintering places. The character of winter weather also affects the numbers of adults surviving. Cold snaps following mild weather are very unfavorable to overwintering green stink bugs.

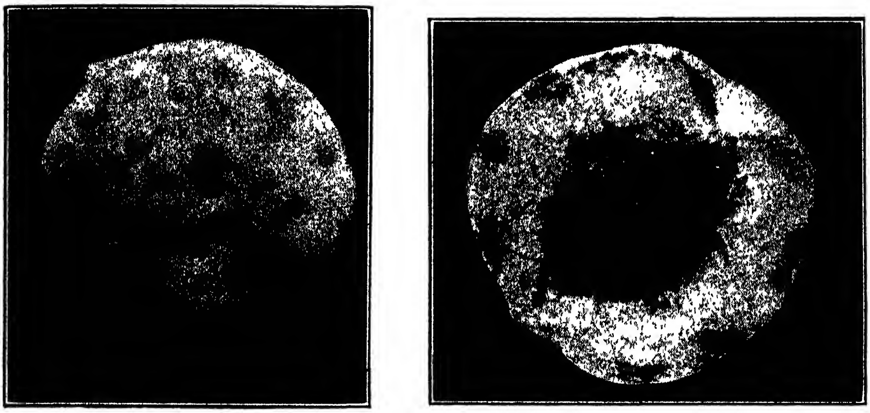

Fig. 3.—Injury by Green Soldier Bug.

Peach Leaf Silver Mite

This pest is not an insect, but a mite. Its name arises from the silvered appearance of infested leaves. The mites feed mostly upon the upper surfaces of the leaves and it is the accumulation of air beneath the cuticle of the leaf loosened by them that gives the characteristic appearance to the injury.

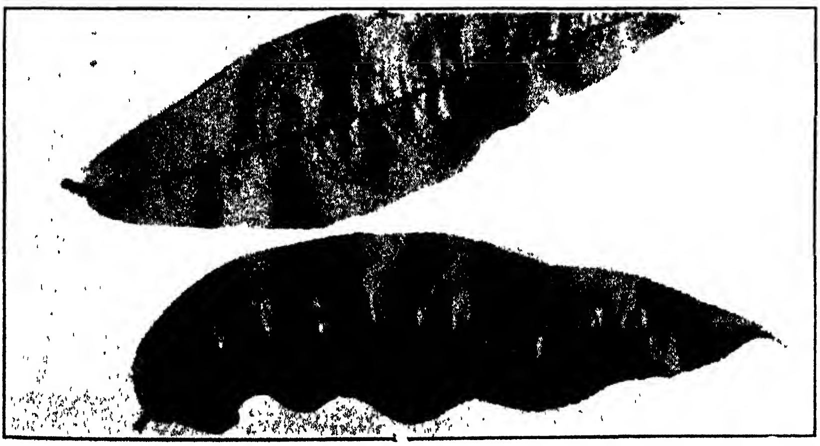

Fig. 4.—Healthy leaf of peach (lower) compared with leaf attacked by peach leaf silver mite (upper).

The mites themselves are of microscopic size and pink in color. The winter is passed beneath the bud scales.

The dormant lime sulphur necessary for peach leaf curl in Michigan keeps the population of this mite at such a low figure that it is seldom noticed. However, it occasionally appears and the contrast of silvery infested and green normal leaves is sometimes striking enough to alarm the orchardist. Peach leaf silver mite has never caused enough damage in this State to warrant specific control measures.

NATIVE PARASITES AS A CONTROL FOR THE ORIENTAL FRUIT MOTH

JAMES M. MERRITT, SECTION OF ENTOMOLOGY

The Oriental fruit moth, primarily a pest of peaches in its range throughout the eastern and north-central United States, has been difficult to control by spray practices because of peculiarities in its life history and habits. Incidentally, it is attacked in various stages by about 60 species of parasites. This situation has instigated considerable work to utilize this parasitism as a supplementary control measure.

Twenty-one species are recorded as attacking the Oriental fruit moth in Michigan, but 19 are not important, none of these having been responsible for more than 1 per cent parasitism during the past three seasons, because of their inability to adapt themselves to the short life-cycle of the fruit moth.

The two species which have been reared in considerable numbers from larvae of the fruit moth collected in Michigan are worthy of study. One is *Glypta rufiscutellaris* Cresson, which has been the most numerous, and is apparently persistent enough to be of value each season. The other, *Cremastus minor* Cushman, has shown ability to reduce the fruit moth population if the conditions are suitable, and for this reason should be considered.

Glypta rufiscutellaris Cresson, a member of the order Hymenoptera, had been collected in Michigan before the advent of the Oriental fruit moth. This parasite attacks the ragweed borer, *Epiblema strenuana,* and probably other insects. It passes the winter, here, in the cocoons of the Oriental fruit moth, nearly full-grown, and emerges as soon as the weather becomes warm, usually before the fruit moth.

The females attack the second generation of the fruit moth, laying their eggs through the twigs as the larvae work inside. This generation appears about the last of June, and it being much larger than the first, the parasites have favorable conditions to establish themselves. *Glypta* has been reared in varying numbers from the subsequent generations of the fruit moth, and seems to be more tolerant of the approach of cold weather than its host, as individuals have emerged from cages kept under field conditions as late as October 5.

The time required for the life cycle of the parasite during the summer months coincides with that of the fruit moth, adult parasites from the

second generation of moths emerging as the third generation moth larvae appear in the orchard. During the past three seasons twenty-five per cent of all the larvae of the fruit moth collected were parasitized by this species. The resulting reduction in the fruit infestation was about 40 per cent, since a higher percentage of parasitism occurred during the second and third broods, and none during the first.

The second species, *Cremastus minor* Cushman, also a member of the order Hymenoptera, in 1931 parasitized 7 per cent of all the larvae collected. Appearing at the beginning of the second generation of the moth, when the larvae were very numerous, this parasite during that generation accounted for 44 per cent of the larvae collected. *Cremastus minor* was recovered in extremely small numbers in that orchard during 1932, but their effective parasitism in 1931 shows that it is a valuable species.

Another parasite of this same type is *Macrocentrus ancylivorus,* a species which has received considerable attention in other peach-growing regions because of its effective control of the peach moth under certain conditions. The Bureau of Entomology of the United States Department of Agriculture has distributed colonies of this species in the areas infested with the fruit moth, including Michigan. The colonies released here, however, are too recently established to draw any conclusions as to their value.

Effective parasitic control requires species active throughout every season. This is particularly true in the case of the fruit moth which can, under favorable conditions, increase very rapidly in a season. The native parasites have been responsible for 30 per cent parasitism of the Oriental fruit moth during the past three years, with a decrease in fruit infestation somewhat more than this figure indicates.

With the variable infestation in most parts of the State, this reduction has aided materially in checking the losses from Oriental fruit moth in many orchards. In the absence of spraying control, this supplementary control by parasites is especially valuable and encouraging, for it indicates that the increase of Oriental fruit moth in Michigan will be retarded by these native allies.

THE OCCURRENCE OF JUNE BEETLES IN MICHIGAN

W. F. MOROFSKY, DEPARTMENT OF ENTOMOLOGY

Common white grubs are the larvae, or young, of our May beetles, or June bugs. These larvae feed on the roots of various plants and have been recognized for years as serious pests, especially to corn, timothy, strawberries, potatoes, roses, and to nursery plantings, particularly those of conifers.

In Michigan, May beetles appear from the middle of April to the last of July or first of August, the period of greatest abundance being between the middle of May to the middle of June. They appear in swarms on oak, ash, hickory, poplar, elm, willow, locust, hackberry, walnut, and other trees at dusk and remain feeding and mating until they return to the soil just before dawn, to reappear the following night. When abundant, the beetles are capable of defoliating large tracts of timber.

The female adults prefer to lay their eggs in grass sod. The eggs are white and are placed in small balls of earth made by the female. The young grubs hatch in 10 to 14 days and begin feeding on roots of plants. They feed for the remainder of the season and then go beneath the plow-line for the winter, returning the following spring to do their greatest damage. In the fall of the second year, they again go beneath the plow-line, to appear the next spring as full-grown larvae. They feed for a short time and then pupate, appearing the following year as adult beetles. Most of our common species of May beetles have this three-year life cycle. This does not mean that all the adults will appear in Michigan every three years. We have recorded three distinct broods. These have been divided into Broods, A, B, and C. Brood A is distributed from Tuscola county across to Muskegon county, covering nearly half the State, Brood B is found in southwestern Michigan, and Brood C in southeastern Michigan. This means the broods overlap and that adult beetles may be found in certain localities two years in succession, as for instance in Kalamazoo county.

In Michigan, Brood A is the largest and most destructive. By records of the broods, one can tell exactly when the adults will appear and also when the greatest damage from the grubs will be done. For example, Brood A in 1932 was abundant in the adult stage. This year, 1933, the white grubs will do a great deal of damage to lawns and to field crops. In 1934, little damage will be done by this brood, and in 1935 we shall have an abundance of large brown adult beetles. During 1933, Brood B will appear in the adult form, and in 1934 Brood C will appear in the adult form.

A particular study has been made of the adult May beetles to determine the number of species found in the State. Up to the present time, 16 species have been recorded in Michigan. All of these 16 species of May beetles are not of economic importance, but perhaps seven or eight species are of importance to agriculturists, nurserymen, greenskeepers, and householders. The Department solicits records of the occurrence of the adult May beetles found in any part of the State and at any time. Send such reports to the Department of Entomology and, if possible, send in a tin box or can containing specimens, always stating how plentiful the insects are and the exact location of their occurrence. Such reports will be used as a basis for perfecting our survey and in keeping our distribution maps up to date. Address letters and packages to the Department of Entomology, Michigan State College, East Lansing, Michigan.

THE BOX ELDER BUG AS A HOUSEHOLD PEST

E. I. McDANIEL, SECTION OF ENTOMOLOGY

During the past three seasons, the box elder bug, *Leptocoris trivittatus*, has been steadily increasing in numbers, and in many localities in the State it has developed into a nuisance in and about houses during late fall and early winter.

The mature insect measures about three-quarters of an inch in length and is dark-grey in color, ornamented with a border of red on the wing covers

and with three red lines on the thorax. The body is bright red with black markings on the sides and with black legs and antennae. The young bugs are bright red, the black markings appearing only when the insects are about half-grown.

The distribution of this pest seems to be confined to the range of the box elder tree. Some authorities go so far as to contend that only the eggs deposited in the opening buds of the pistillate box elder trees hatch and produce young. At any rate, the young of the box elder bug may be found feeding almost anywhere during June and July. The foliage and tender growth of box elder and ash seem to be preferred, but occasionally the young are to be found feeding on the foliage and fruits of strawberry, apple, peach, plum, and pear. When they feed on the fruit, they cause it to become dimpled and deformed.

The young box elder bugs feed throughout the summer and by early fall have completed their growths. The first few cool evenings witnesses the congregation of these young adults on the trees, sometimes in such numbers that the trunk of a tree appears as a solid mass of bugs. The bugs disperse eventually, seeking winter quarters. Some find protection in fence corners under rubbish, some in out-buildings, and altogether too many find their ways into dwellings. Such migrations usually start in September and continue until after the first heavy snowfall.

The box elder bug is harmless insofar as any damage it is capable of doing in the house, but the very presence of these brilliantly-marked insects is disturbing. The only control measure that is practical is the use of a contact insecticide when the bugs are congregating on the trunk and limbs of the trees. Later, after they have gained entrance into the house, the only remedial measure is to sweep up and burn them, or destroy by dropping into kerosene or some contact insecticide such individuals as can be collected.

The elimination of box elders in the vicinity of houses would settle the local question of control measures for all time.

TRENDS IN THE USE OF FARM LANDS IN THE UPPER PENINSULA OF MICHIGAN

E. B. HILL, SECTION OF FARM MANAGEMENT

In a plan for the best utilization of land in Michigan, first consideration should be given to the possibilities of its use and value for farming. Within the last two or three years, much attention has been given to the study and planning of the utilization of land in the Upper Peninsula of Michigan.

In order to present a little better conception of this region, some figures will be given for the purpose of showing its relation to the State as a whole. The Upper Peninsula has about 29 per cent of the total land of the State, 7 per cent of the land in farms, 5 per cent of the improved land in farms, and 8 per cent of the farms. It should be stated in this connection, however, that the major agricultural development in the Upper Peninsula started one generation or more later than it did in the Lower Peninsula.

The greatest period of agricultural development of the Upper Peninsula of Michigan occurred between 1900 and 1920. During this period, the number of farms and the amount of land in farms doubled. The increase in the amount of land in farms continued and reached the peak in nine counties in 1925. The land area in farms was still increasing after that date in five other counties, Delta, Houghton, Iron, Luce, and Marquette. The total number of acres in farms in 1930 (1,252,179) was about 3 per cent or 38,000 acres less than in 1925 (1,290,446) but exceeded the 1920 figure (1,181,009) by about 71,000 acres, or 6 per cent.

The local mining and lumbering industries aided much in the development of the agriculture of this region. Thus, the present condition of its agriculture is affected greatly by curtailed activities in these industries. This region is naturally suited to hay pasture crops. Hay was formerly an important cash crop. The rapid decline in horse population and the resulting decline in the outside demand for hay affected adversely many areas in this section of the State. The dairy cattle enterprise has been expanded to utilize a large portion of the hay which was formerly shipped to outside markets.

The population of the Upper Peninsula in 1930 was 318,696 persons as compared to 332,556 in 1920. This is a decline of about 14,000 persons or 4.2 per cent since 1920. This decline in population has taken place mostly in the mining regions. The local markets consume much of the products produced in this region. Out of a total population of 332,556 in 1930, only 20 per cent (63,392 persons) were on farms. The balance, or 80 per cent, furnish an important market for local farm products. In 1932, about 42 per cent of the potatoes and 11 per cent of the hay was shipped out of the county in which it was grown.* No oats, wheat, or rye was shipped out.

The type of farming followed in the Upper Peninsula is based primarily on hay and pasture crops, grain, potatoes, and dairy cattle. The farms have a relatively small acreage of tillable land, the average per farm being 41 acres in 1929. An average for the 15 counties shows 54 per cent of the tillable land in hay, 15 per cent in tillable pasture, 14 per cent in oats and barley, and 3 per cent in potatoes. Of the remaining 14 per cent, idle or fallow land constitutes 6 per cent, corn, clover seed, wheat and mixed grain 1 per cent each, and miscellaneous crops 4 per cent.

Farm Land Acreage Low

In 1930, about 12 per cent of the land area was in farms. This was double the percentage in 1900. Menominee county leads with 33 per cent, followed by Houghton with 22, Delta with 20, and Chippewa with 18 per cent. Gogebic, Schoolcraft, Luce, and Keweenaw have 5 per cent or less of their land area in farms. The data for each county are shown in Table 1.

The data by townships, presented in Figure 1 show even more variation in the percentage of land area in farms. In Alger county, for example, four townships representing 75 per cent of the area of the county have only from 1 to 3 per cent of their total land area in farms. Similar situations prevail in Gogebic, Keweenaw, Luce, Mackinac and much of Chippewa counties.

The total number of farms in this region reached a peak of 14,272 in 1925. The 1930 census reports a decrease of about 8.5 per cent from 1925. Dickinson and Iron were the only counties which showed an increase in the

*March, 1933, Crop Report for Michigan.

Table 1.—The per cent of land in farms and the number of farms by counties for the Upper Peninsula of Michigan.

County	Per cent, land in farms			Number of farms				
	1930	1920	1910	1930	1925	1920	1910	1900
Alger	7	5	5	511	572	386	278	124
Baraga	9	8	6	713	817	653	412	241
Chippewa	18	18	18	1,446	1,730	1,569	1,409	1,036
Delta	20	19	15	1,384	1,468	1,395	1,128	868
Dickinson	9	11	5	513	479	429	235	118
Gogebic	5	4	2	726	808	528	257	80
Houghton	22	21	14	1,840	1,971	1,741	1,033	362
Iron	8	6	4	801	783	621	381	231
Keweenaw	2	1	1	102	188	72	36	22
Luce	4	4	4	178	195	194	195	144
Mackinac	7	8	9	415	593	479	490	394
Marquette	8	7	6	1,006	1,108	846	661	513
Menominee	33	33	25	1,961	1,978	2,106	1,677	1,430
Ontonagon	11	9	5	1,134	1,124	917	371	187
Schoolcraft	5	6	6	357	458	381	441	352
Totals	12	11	9	13,087	14,272	12,317	9,004	6,102

number of farms from 1925 to 1930. The number of farms by counties from 1900 to 1930 is shown in Table 1.

The number of acres of land per farm averaged 96 in 1930 which is but little less than the average for the State. The acreage per farm was larger in 1900 and 1910, when the averages were 109 and 102 respectively. The data by counties are presented in Table 2.

One of the limiting factors in the farming of this region is in the small amount of tillable land per farm. In many sections, land clearing is rather a costly and laborious undertaking. The increase in the tillable acreage per farm has been extremely slow. In 1899, the average number of acres of improved land per farm was 36. This number increased to 38 in 1909, remained constant during the next census period, and increased to 41 acres

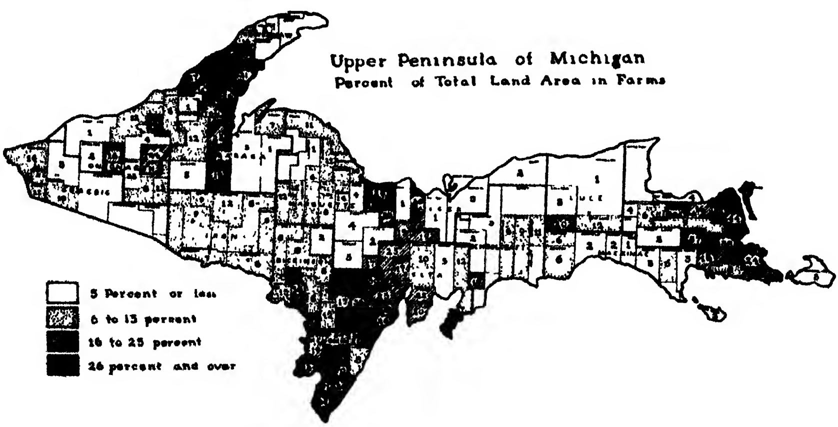

Figure 1.—A map which shows the per cent of total land area in farms by townships in the Upper Peninsula of Michigan. The three areas of greatest development are in the eastern, southern, and northern portons.

per farm in 1929. This was an average increase of only 5 acres per farm for the 30-year period, see Table 2. The relatively slow increase in the amount of tillable land per farm may be more apparent than real. During the period 1899 to 1929, there has been a considerable increase in the total amount of tillable land but the number of farms has likewise increased. Thus, the smaller acreage of tillable land per farm on the newer farms tends constantly partially to off-set the larger acreages on the older farms.

Table 2.—The number of acres per farm and the number of tillable acres per farm by counties for the Upper Peninsula of Michigan.

County	Acres per farm				Tillable acres per farm			
	1930	1920	1910	1900	1929	1919	1909	1899
Alger	84	79	106	117	34	22	20	18
Baraga	77	75	85	121	26	22	23	24
Chippewa	126	118	126	117	76	68	57	47
Delta	107	102	100	108	42	38	38	38
Dickinson	92	125	100	105	33	35	35	43
Gogebic	49	52	51	46	21	19	19	13
Houghton	79	77	91	134	36	33	35	50
Iron	78	69	77	100	29	23	24	23
Keweenaw	65	68	76	168	27	28	34	70
Luce	144	124	106	95	59	52	41	30
Mackinac	116	111	119	121	55	45	43	38
Marquette	98	105	103	105	32	33	35	35
Menominee	115	106	99	93	45	41	38	32
Ontonagon	81	87	103	139	31	27	32	30
Schoolcraft	109	113	103	110	48	42	35	30
Averages	96	96	102	109	41	38	38	36

The change in acreage of tillable land per farm has not been uniform, however, in the different counties. Practically no change in this respect has taken place in the last 30 years in Baraga, Houghton, and Ontonagon. The average number of tillable acres per farm in the following counties was less in 1929 than in 1909: Dickinson, Keweenaw, and Marquette. Major increases occurred in Alger, Chippewa, Luce, Mackinac, Menominee, and Schoolcraft. Four counties, Baraga, Gogebic, Iron, and Keweenaw have an average of less than 30 tillable acres per farm.

Recent Trends In Crop Acreages

Although the census data of 1919 and 1929 are not sufficient to indicate the long-time trend in crop acreages, they do give a fairly good idea of the present situation, assuming the years to be fairly typical of the period.

Hay was an important cash crop in this section of the State. Over half the tillable land in each farm on the average is now in this crop. There was 3 per cent more in 1929 than in 1919. Baraga, Gogebic, Houghton, Keweenaw, Iron, Marquette, and Ontonagon counties have about 60 per cent or more of their tillable land in this crop. Since clover is quite well adapted to the soil and climate conditions of this region, alfalfa acreage has not increased as fast as it has in the Lower Peninsula. Delta, Dickinson, Luce, Mackinac, and Menominee counties show a considerable increase in this crop.

With the grain crops, there has been a decided decrease in the acreage

of oats and an increase in barley and mixed grains. Oats constituted 15 per cent of the tillable acreage in 1919 and 9 per cent in 1929. The percentages are fairly constant for the different counties. Barley increased from 2 per cent in 1919 to 5 per cent in 1929.

Potatoes, the most important cash crop of the Upper Peninsula, occupies from 3 to 4 per cent of the tillable area. The percentage was somewhat smaller in 1929 than in 1919.

Corn is of relatively little importance except in Menominee and in the southern portions of Delta and Dickinson counties. Wheat occupied a good acreage during 1918 and 1919 but since has dropped practically out of the picture.

Acreage of land in plowable pasture increased from 9 per cent in 1924 to 15 per cent in 1925. The increase in hay and in pasture land is a logical development to accompany the livestock industry of this region.

In summing up the data on the trends in the use of farm lands in the Upper Peninsula, the following points seem to be of most importance: (1) the future possibilities of agriculture in the region depend largely upon the favorable developments in business and agriculture of the country as a whole; (2) acreage of land in farms increased some since 1920, and is about the same as in 1925; (3) although there are possibilities of additional agricultural development in some sections, many large areas show little or no development in agriculture at present, nor give evidence or possibilities for development in the future; (4) very slow increase in acreage of tillable land per farm; (5) increase in percentage of tillable land in hay, pasture, barley, and idle or fallow land; and (6) decrease in oats, corn, wheat, and, in some counties, potatoes.

COST OF PRODUCING MICHIGAN BEANS IN 1932

A Favorable Growing Season Was Largely Responsible for the Good Yields and Lower Cost Per Bushel

P. F. AYLESWORTH, SECTION OF FARM MANAGEMENT

The average 1932 yield for the State was 14.8 bushels of beans per acre, the highest since the beginning of official records in 1914, according to V. H. Church of the Division of Crop and Livestock Estimates. The average yield per acre for the 10 years preceding 1932 was 10.6 bushels. The 58 navy bean growers cooperating in this project with the Farm Management Department had an average yield of 21.6 bushels per acre in 1932. The average yield per acre for the cooperators for the three years previous was 11.8 bushels.

The average figures for these growers gives a composite picture of the economic side of bean production this year. These 58 navy bean growers had an average of 19.8 acres of beans per farm. In this group, there were

19 growers using commercial fertilizer, and they applied about 80 pounds per acre. Approximately 60 per cent of the men plowed under a fair growth of some crop as a green manure. An average of 46 pounds of seed was used per acre, and 58 per cent of the men used Robust seed. The average date of planting in 1932 was about June 8. Up until pulling time, 11.5 hours of man labor had been spent on each acre. In the harvesting operations, 8.1 hours additional man labor were used for each acre in beans. The total cost of production averaged $20.08 an acre. Allowing a credit of $1.28 per acre for pods, the net cost was $18.80 on the 21.6 bushels. This amounts to 87 cents a bushel, or $1.45 a hundred pounds.

Table 1 shows how the costs this year compare with the past three years. Though the total cost per acre has been reduced 45 per cent from that of 1929, the cost per bushel has been lowered even more due to high yields in 1931 and 1932. The drop in value, however, has been even more rapid. The major portion of the reduction in costs was in growing the crop, rather than in harvesting or in the charge for use of land. The difference in the charge for man labor in growing, and for seed used accounts for over one-half the reduction in cost from 1929 to 1932 in the growing cost. Practically the same amount of time was spent on each acre, but the rate was lowered from 35 cents an hour in 1929 to 15 cents in 1932 in accordance with lowered hired

Table 1.—Navy bean production costs for 1929, 1930, 1931 and 1932. Items of cost are shown on an acre basis and are for all farms in the navy bean area.

YEAR	1929	1930	1931	1932
NUMBER OF FARMS	133	85	92	58
GROWING COSTS (per acre):				
Man labor	$4.80	$3.05	$2.30	$1.73
Horse labor	2.44	2.22	1.85	1.46
Tractor labor	2.88	2.45	1.75	1.92
Machinery	1.25	1.00	1.02	.91
Seed	4.17	2.77	1.69	.98
Barnyard manure	3.18	2.55	2.93	2.51
Green manure	.88	.78	.41	.48
Fertilizer	1.20	1.01	.56	.33
General farm expense	2.30	2.00	1.47	1.04
Miscellaneous	.22	.05	.02	.03
TOTAL	$23.32	$17.88	$14.09	$11.39
HARVESTING COSTS (per acre):				
Man labor	3.29	1.96	1.82	1.36
Horse labor	.81	.73	.65	.51
Machinery	.52	.39	.38	.31
Threshing	1.34	1.04	1.30	1.39
Miscellaneous	......	......	......	.01
TOTAL	$5.96	$4.12	$4.15	$3.58
Use of land	6.95	6.38	6.36	5.11
TOTAL COST (per acre)	$36.23	$28.38	$24.60	$20.08
Yield per acre (bu.)	12.1	9.4	14.1	21.6
Average pick (per cent)	1.9	1.5	3.0	2.4
Net cost per bushel	$2.88	$2.91	$1.66	$0.87
Net cost per cwt.	4.80	4.85	2.77	1.45
Farm value per cwt., December 1	5.94	3.75	1.76	1.00
Cash cost per acre	......	......	6.78	5.59
Acres in beans (per farm)	25.5	25.5	22.7	19.8
Variety (per cent with Robust)	50	64	58	58
Seed (lbs. per acre)	45.0	45.0	50.0	46.5
Commercial fertilizer (lbs. per acre)	77.0	69.0	40.0	25.7
Manure 1932 (loads per acre)	......	......	......	2.6
Man labor (hours per acre)	23.2	20.0	21.2	20.6
Horse labor (hours per acre)	21.6	19.6	20.7	19.6
Tractor use (hours per acre)	3.4	2.7	2.1	2.4

labor rates. About the same amount of seed was also used, but its value was less. In almost every case, the reduction in cost was due not to less of the item being used, but to lower cost or lower value each succeeding year.

The results on individual farms vary widely from the average in various items. Some of these variations are due to conditions over which the operator has little or no control, while other differences are largely the result of his management and practices he follows. The question arises as to what practices are important in increasing yield and lowering the cost per bushel.

The farms were first divided according to soil type to eliminate if possible the differences in natural fertility of soil. The farms were then sorted according to yield per acre and various factors calculated to show their effect on yields, see Table 2.

Table 2.—Effect of yield per acre on costs—1932.

SOIL TYPE	Miami soils			Brookston soils		
YIELD GROUPS	Under 15	15 22	Over 22	Under 20	20–27	Over 27
Number of farms	5	6	5	14	14	14
Average yield per acre (bu)	9 3	18 3	23 2	15 4	23 4	31 0
Acres per farm	18 8	16 0	15 3	18 1	25 7	18 3
Per cent with Robust	40	83	60	14	64	93
Pounds of fertilizer per acre	1 3	29 2	9 2	15 5	10 4	70 6
Average planting date	6 11	6/13	6/7	6/9	6 7	6 6
Acre Costs:						
Man labor growing	$0 89	$1 81	$2 02	$1 87	$1 75	$1 77
Cost of seed	50	1 05	69	1 14	89	.90
Green manure	90	15	21	44	44	62
Barnyard manure	19	2 05	1 85	1 87	3 11	3 31
Commercial fertilizer	02	37	13	15	15	95
Growing cost	6 21	11 42	9 85	11 37	11 42	13 73
Total cost	$11 11	$18 95	$17 72	$19 32	$20 85	$24 13
Net cost per bushel	1 15	1 00	72	1 21	85	71

The high yield group in each case had somewhat higher costs per acre but considerably lower cost per bushel. The cost of producing an acre of beans varies according to the intensity of culture, or in other words, the methods and practices followed. On the Brookston soils, the yield in the high-yield group was double that of the low-yield group and the cost per bushel was one-third less.

Table 2 gives an indication of the importance of certain factors in accounting for differences in yield. Subsequent sorts showing the effect of these factors on yields and costs give an idea of their relative importance. The farmers that plowed under a green manure crop or barnyard manure had higher yields than those that did not. Applications of commercial fertilizer also resulted in higher yields. The growers planting their beans before June 7 had higher yields than those planting later. This is one factor that does not result in a higher cost per acre and showed a reduction in cost per bushel. There was a distinct tendency for farmers having small acreages of beans to have higher costs per acre. These men spent more time and used more manure and fertilizer. Their yields averaged higher, so the net cost was about the same as those having larger acreages of beans. Robust beans out-yielded other varieties by quite a margin, although some of the higher yield might be due to other factors.

In studying the influence of any one factor upon yields and costs there was a difficulty of eliminating the effect of other factors. Results seem to indicate that the men following one good practice tend to follow others that increase the yield. A final sort made according to the number of good practices a farmer followed bears out this theory. The following standard was used for grading the farms: (1) planted before June 7; (2) Robust beans used; (3) more than average total fertilizer, \$3.75 per acre; and (4) more than average man labor charge, \$3.18 per acre. The men "making the grade" in at least three of the four factors averaged over 30 bushels per acre, or 68 per cent more than those of the group following not over one of the good practices.

The results of these navy bean growers indicate what may be done to reduce the cost of producing beans in 1933:

(a) Grow the beans only on soils and in areas suited to their production.
(b) Rotate the crops so that a green manure crop can be plowed under.
(c) Apply manure at a moderate rate covering as many acres as possible.
(d) Use seed of the Robust variety.
(e) Seed the beans the first part of June.
(f) Make better use of labor by eliminating small fields and by thorough preparation of soil prior to seeding.

POTATO COSTS IN MICHIGAN IN 1932

Acre Costs In 1932 Average 30 Per Cent Less Than In 1931

K. T. WRIGHT, SECTION OF FARM MANAGEMENT

One hundred farmers in four potato areas of the State of Michigan kept complete cost records on their potatoes during 1932. These men kept a record of the amount of labor, seed, fertilizer, spray material and all other expenses chargeable to the potato crop. Approximately one-fourth of the cooperators were located in each of the four areas designated as the Upper Peninsula, Northern, Western, and Eastern areas. The men were widely scattered over the Upper Peninsula, but in the other areas they were located in three or four counties. In the Northern area Antrim, Charlevoix, Emmet, and Otsego counties were included. In the Western area Kent, Mecosta, Montcalm, and Oceana completed the group. The Eastern area included Lapeer, Oakland, and Tuscola counties.

There were both certified and table stock producers in each of these areas except the Upper Peninsula where all the cooperators were certified seed growers. Since there is so much difference in the methods and costs of the certified and table stock producers, the average results of each have been presented separately for each area. Table 1 contains the data for the men growing certified seed. A comparison of the areas brings out some interesting differences, not only in yields, but in practices and costs as well. The

Upper Peninsula growers, for instance, spend about 40 per cent more time per acre than even the men in the Northern area, and far more than the other certified growers. They had a smaller acreage of potatoes, used more seed, sprayed as much or more, used more commercial fertilizer, had higher costs per acre, obtained a much higher yield, and had a lower cost per bushel.

Table 1.—Certified seed potato production costs per acre for 1932 by areas.

AREA	U. P.	Northern	Western	Eastern	Average all 47 farms
NUMBER OF FARMS	22 farms	14 farms	9 farms	2 farms	
GROWING COSTS (per acre):					
Man labor	$8 46	$7 63	$4.71	$4.39	$6 89
Horse labor	4.34	3.20	4.59	3.24	4.01
Tractor use	2.65	4.37	.88	....	2 57
Machinery	8.54	4.26	2.39	3 26	5.06
Seed	11.87	8.90	6 36	12.38	9.22
Seed treating material	.84	.54	.41	.63	.60
Commercial fertilizer	10 78	2.17	2 10	......	4 91
Barnyard manure	4 84	4.09	3 65	7.62	4.33
Green manure	.39	96	1 07	2 00	.84
Spray material	3 63	3 67	2 09	2 32	3 12
Certification	7 68	5 75	1.90	5 08	5 17
General farm expense	6 45	4 75	2.57	3 24	4 58
TOTAL	$70 47	$50 29	$32 72	$44.16	$51 30
HARVESTING COSTS (per acre):					
Man labor	10 70	6.60	3 01	5.32	6.80
Horse labor	1 50	.95	1 16	2 09	1.23
Machinery	3 59	2 41	1 27	2 96	2 47
Miscellaneous	.55	1.11	.. ...	..	54
TOTAL	$16 34	$11 07	$5 44	$10 37	$11 04
Use of land	3 77	2 63	3 28	3 46	3 24
TOTAL COST (per acre)	$90 58	$63 99	$41.44	$57 99	$65 58
Yield per acre (bu)	426	264	147	303	283
Cost per bushel (total crop)	$0 21	$0 24	$0 28	$0 19	$0 23
Per cent certified No. 1 potatoes	94	70	44	72	78
Estimated farm value (No. 1s)	$0 40	$0 40	$0 40	$0 40	$0 40
Cash cost per acre	$41 96	$27 40	$16 00	$24.28	$28.63
Acres in potatoes (per farm)	5 4	8 4	12 4	6 4	7 7
Variety (per cent with Russet Rural)	61	94	91	100	79
Seed (bushels per acre)	22.5	19 7	15 5	17 2	19 3
Commercial fertilizer (lbs. per acre)	548	182	92	... ...	269
Manure 1932 (loads per acre)	7.0	6 1	5 6	12 7	6 5
Number sprays	5 9	5 9	4 5	3 0	5.5
Man labor (hours per acre)	127 6	94 9	51 4	64 8	91.2
Horse labor (hours per acre)	62.6	41.5	57.5	53.3	53 8
Tractor use (hours per acre)	4 3	6 8	1 2	... .	2.5

The certified growers in the Northern area tend to follow much the same practices, although they used less commercial fertilizer and spent less time, but most of the difference in labor was in harvesting. The cost per acre on these farms averaging 8.4 acres of potatoes per farm was $63.99 compared to $90.58 for the Upper Peninsula men who had 5.4 acres. The certified growers in the Western area had 12.4 acres in potatoes and an average cost of $41.44 an acre. Less seed, less commercial fertilizer, less manure, fewer sprays, and less labor are evident on these farms. Their yield was much less, and the cost per bushel was higher than in the other two areas, due either to the above differences, unfavorable weather, or both.

The table stock producers in the Northern area follow many of the practices of the certified growers, Table 2. They used more seed per acre, applied more commercial fertilizer, sprayed at least twice more than the table

Table 2.—Table stock potato production costs per acre for 1932 by areas.

AREA	Northern	Western	Eastern	Average all 57 farms
NUMBER OF FARMS	9 farms	23 farms	25 farms	
GROWING COSTS (per acre):				
Man labor	$6.43	$4.01	$3.71	$4.17
Horse labor	3.90	3.44	2.98	3.28
Tractor use	1.49	1.69	1.22	1.44
Machinery	4.21	2.44	1.35	2.16
Seed	4.78	3.21	4.38	3.96
Seed treating material	.32	.16	.22	.21
Commercial fertilizer	1.39	.31	1.30	.90
Barnyard manure	5.28	5.18	5.50	5.34
Green manure	.37	.97	.75	.79
Spray material	1.63	.96	.42	.79
General farm expense	3.85	2.45	2.83	2.81
TOTAL	$33.65	$24.82	$24.66	$25.85
HARVESTING COSTS (per acre):				
Man labor	5.13	3.34	4.79	4.24
Horse labor	1.12	1.22	1.05	1.13
Machinery	1.78	1.01	.91	1.06
Miscellaneous	......	.20	.15	.15
TOTAL	$8.03	$5.77	$6.90	$6.58
Use of land	2.69	3.00	3.81	3.34
TOTAL COST (per acre)	$44.37	$33.59	$35.37	$35.77
Yield per acre (bu.)	156	138	167	154
Cost per bushel (total crop)	$0.28	$0.24	$0.21	$0.23
Per cent No. 1 potatoes	79	78	85	82
Estimated farm value (No. 1s)	$0.15	$0.20	$0.25	. .
Cash cost per acre	$12.12	$8.44	$10.20	$9.58
Acres in potatoes (per farm)	8.0	10.1	10.7	10.0
Variety (per cent with Russet Rural)	80	79	71	75
Seed (bushels per acre)	16.3	12.6	11.6	12.6
Commercial fertilizer (lbs. per acre)	101	21	76	57
Manure 1932 (loads per acre)	7.7	7.8	7.5	7.7
Number sprays	3.6	1.5	1.1	1.6
Man labor (hours per acre)	77.1	49.1	56.6	56.1
Horse labor (hours per acre)	50.2	46.6	40.3	44.1
Tractor use (hours per acre)	1.9	2.2	1.5	1.8

stock producers of other areas, and spent more time on each acre of potatoes. The yield last year, however, was the same as the average of all table stock producers, so the higher cost per acre gave a cost of 28 cents a bushel. The 23 cooperators in the Western area produced an average of 138 bushels per acre at a cost of $33.59, a cost per bushel of 24 cents. The men in the Eastern area on the average received more rainfall in September and averaged 167 bushels per acre. The cost totaled $35.37 an acre or 21 cents a bushel.

Major Factors Influencing Yields and Costs

In any farm management study of this kind, it soon becomes apparent that the results on farms vary widely from the average in various items. Some of the variations are due to conditions over which the individual farmer has no control, while many other differences are largely the result of individual management. In this project, the particular interest is in studying that large group of practices and methods over which the farmer has control, in order to measure the influence of each factor upon the yield and the net cost of the potatoes. Individual farm variation in cost per bushel in the table stock group was from 11 cents to $1.30 a bushel, and from 14 to 64 cents in the certified group.

Table 3 shows the relation of yield to costs per acre and per bushel. In both the table stock and certified groups, it will be observed that the high yield one-third had distinctly higher costs per acre but considerably lower costs per bushel. Apparently, the cost of producing an acre of potatoes is not a certain set amount but depends largely upon the intensity of culture, or in other words, the methods and practices followed. A study of the items listed shows that in general the high yield groups followed more of the approved practices than the lower yield groups.

Table 3—Effect of yield per acre on costs—1932.

ITEMS	Table stock			Certified		
YIELD GROUPS........ ...	130 and less	131–180	181 and over	264 and less	265–374	375 and over
Number of farms	19	19	19	16	15	16
Average yield	104	161	218	175	311	475
Acres per farm	10 8	11 6	7 7	9 4	7 8	5.2
Bushels seed per acre ...	10 0	13 0	15 5	17 8	20 8	22 0
Cost of seed per bu ...	$0 27	$0 32	$0 35	$0 41	$0 48	$0 58
Number treating seed .. .	9	11	16	16	15	16
Com. fertilizer (lbs. per acre)	10	101	70	119	261	592
Acre Costs:						
Man labor--growing ..	$4 08	$4 02	$4 53	$5 78	$7 61	$8 55
Cost of seed	2 70	4 12	5 47	7 32	9.95	12 79
Seed treating material .	13	.16	.39	45	66	.88
Spray material	59	93	87	2 60	3 33	4.15
Green manure . .	91	57	96	1 02	93	36
Barnyard manure .	4 11	5 43	7 00	4 18	4 07	5.46
Commercial fertilizer .	15	1 36	1 28	2 41	4 12	11 15
Growing cost .	21 08	26 59	31 46	38 80	55 42	74 44
Total cost ..	29 01	36 83	43 68	48.90	72 13	94 61
Cost per bushel	28	23	.20	28	23	20

The range in yield on individual farms was from 36 to 615 bushels per acre. Doubling the yield per acre reduced the cost per bushel approximately 30 per cent even under the adverse economic conditions of 1932. The use of commercial fertilizer was one of the most important factors influencing yield. The number of sprays was another important item. The seed charge per acre, which is dependent upon the spacing in the rows and between rows, and upon the quality of seed, showed a high correlation to yield. Treating the seed also resulted in higher yields. There appeared to be an advantage in early planting and in fall plowing. The use of barnyard and green manure both gave fair increases in yield. The growers having small acreages averaged considerably higher yields, but their costs per acre were enough higher to balance the higher yield.

Summary

Certified Growers:

1. The 47 certified growers cooperating in this study averaged 7.7 acres of potatoes per farm.
2. These men used 19.3 bushels of seed per acre which was valued at 48c per bushel. Seventy-nine per cent of them grew Russet Rurals.
3. Sixty-six per cent of the certified growers used commercial fertilizer. The average application was 416 pounds per acre for those applying fertilizer.

4. The total fertilizer charge per acre as an average of all certified farms was $10.08. This included an average of 269 pounds of commercial fertilizer, 6.5 loads of manure applied in 1932, and the green manure plowed under.
5. All of the growers in this group treated their seed. They also sprayed all the potatoes. The average number of sprays was 5.5.
6. This group of growers spent 91 hours of man labor, 54 hours of horse labor, and 2.5 hours tractor time per acre for growing and harvesting the crop.
7. The cost of growing the crop averaged $51.30, while harvesting cost $11.04, and use of land $3.24, making a total of $65.58 per acre.
8. The average yield was 283 bushels, so the cost was 23 cents per bushel.
9. Man labor constituted 21 per cent of the total cost, the use of horses, tractor, and machinery 24 per cent, fertilizer 15 per cent, seed 14 per cent, spraying and treating material 6 per cent, certification 8 per cent, and general expense and use of land 12 per cent.
10. Cash costs were $28.63 per acre or 43 per cent of the total cost.

Table Stock Producers:

11. The 57 table stock producers averaged 10.0 acres of potatoes per farm.
12. These men used 12.6 bushels of seed per acre valued at 31 cents per bushel.
13. Only 21 per cent of these men used commercial fertilizer. They applied an average of 287 pounds to the acre.
14. This group applied 7.7 loads of manure per acre as an average and plowed under about the same amount of green manure as the certified growers.
15. Sixty per cent treated their seed and 74 per cent sprayed their potatoes. The average number of sprays for all fields was 1.6.
16. The table stock producers spent 56 hours of man labor, 44 hours horse labor, and 1.8 hours tractor time per acre for growing and harvesting.
17. The cost of growing the crop averaged $25.85, while harvesting cost $6.58, and use of land $3.34, making a total of $35.77 per acre.
18. The average yield was 154 bushels, so the cost was 23 cents per bushel.
19. Man labor constituted 24 per cent of the total cost, fertilizer 20 per cent, seed 11 per cent, spray and treating material 3 per cent, and general expense and use of land 17 per cent.
20. Cash costs were $9.58 per acre or only 27 per cent of the total cost.

A STUDY OF VITAMIN D IN NORMAL MILK

H. ERNEST BECHTEL AND C. A. HOPPERT, SECTION OF DAIRY HUSBANDRY

There is need for additional information concerning the vitamin D potency of normal cow's milk. It has been estimated that fully 75 per cent of the children in cities develop at least a mild case of rickets during the first twelve months of life. Because milk is the essential and basal article of diet throughout the rachitic age of the infant, nutritional research is emphasizing its content of vitamin D. Several methods have been advanced for increasing the amount of this vitamin in cow's milk, which show that vitaminized milk is a specific prophylactic and therapeutic agent for rickets. However, not enough is known of the antirachitic properties of normal milk in the different areas of this country.

The results of certain investigators indicate that normal milk contains not more than five or six Steenbock rat units of vitamin D per quart. This work is summarized as follows:

Krauss, Bethke & Wilder (Ohio)............. 2.76 units per quart
Supplee, Hanford, Dorcas & Beck (New York).. 5.00 units per quart
Mitchell, Eiman, Whipple & Stokes (U. of Pa.). 6.00 units per quart

Human infants develop rickets when given milk containing but five units of vitamin D per quart.

The Dairy Section in cooperation with the Department of Biological Chemistry is making a study of the vitamin D content of raw whole milk from the College herd. Samples of milk fat are obtained once each month from the three-time milking cows and assayed biologically according to established procedures. Both white and piebald rats are taken from the stock colony at 28 to 30 days of age. The Steenbock and Black rachitogenic diet, modified with 38 per cent oat meal in place of 38 per cent of corn meal, is fed for 21 days, followed by 10 days of supplemental feeding of weighed portions of butterfat. During the test period, the rats are maintained in individual wire-bottom cages. At the end of this period, the line test is made and the results interpreted in terms of Steenbock rat units of vitamin D.

Table 1.—Biological assays of butterfat.

Date of Sampling	Curative Material	Rat Units of Vit. D	Number of Rats
August 20, 1932	2.5 gms. butterfat	1 –	8
August 20, 1932	3.0 gms. butterfat	1	8
August 20, 1932	3.5 gms butterfat	1 +	8
August 20, 1932	1.0 cc. diluted cod liver oil*.	1	2
August 20, 1932	1.0 cc. corn oil	0	1

*Diluted to contain one rat unit of vitamin D per cubic centimeter.

that during the summer of 1932 the starling was much more in evidence on the east side of the State than ever before, that it appeared in countless flocks numbering into the hundreds, perhaps thousands. At their Croswell orchard, consisting of 200 acres, it was estimated conservatively that in three days the starlings consumed not less than 20 tons of cherries. Similar reports of cherry damage have been recorded from orchardists in Ohio and Connecticut. In addition to such depredations, the starling has been reported as doing considerable damage to other small fruits, garden truck, corn, apples, peaches, and pears. Reports also state that it robs the nesting sites of hole-nesting native birds such as the bluebirds, flickers, purple martins, and house wrens. To prevent the starling from taking nesting boxes of our native birds, the entrance holes should measure not more than one and one-half inches in diameter.

The starling in Michigan is not protected by state law but one is held liable to prosecution if protected native birds are killed when carrying out eradication campaigns against the starling.

It is unfortunate that practically no experimental work has been done to devise methods for eradicating starlings from agricultural areas. It is true, however, that the bird is wary and is easily frightened. Continued vigilance must be employed in order to insure protection from damage to crops. Cherry orchardists may prevent great losses by keeping a constant watch for approaching flocks of starlings during the few days previous to the ripening of the crop. When the birds appear, the use of a shotgun discharged at the flock has proven effective, provided constant watch is kept and the flock shot at several times a day. Such a method necessarily means man-power and increased cost but may prove a saving of much money in the end.

The nests of the starlings should be destroyed when it is possible to do so, but care must be used not to destroy the nests of the more favorable native birds.

Where large flocks of starlings gather at a common roost in the late summer and fall they have been decreased in numbers by community-shoots.

Much success may be had using grain to attact the starlings into pig pens, barns, or other farm buildings during the winter season. The starlings will enter buildings through any sort of opening and if such openings are closed after the birds have entered they may be disposed of easily. They have entered pig pens to feed upon garbage or food placed in the troughs and if such pens can be closed to exit the birds may be captured and destroyed.

For a more complete study of the European starling, the following bulletin may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C., at 5c per copy: Farmers' Bulletin No. 1571, "The European Starling In The United States."

If any serious outbreaks of the starling occur any where in Michigan this coming summer, it is requested that the Zoology Department of Michigan State College be notified.

1932 EXPERIMENTS WITH ALFALFA AS PASTURE FOR DAIRY COWS

A. B. DORRANCE AND H. C. RATHER, SECTION OF FARM CROPS[1]

Alfalfa as a pasture for dairy cows proved even more satisfactory in 1932 than it did in 1931 in these experiments, conducted at the W. K. Kellogg Farm, Augusta, Michigan. Under the influence of additional fertilization and a more favorable season, the alfalfa was more than twice as productive in 1932 as it was the previous season and this increase was reflected in the much greater carrying capacity of the pastures and a better distribution of grazing throughout the summer months when it was most needed.

Despite the fact that rains were frequent and the alfalfa was often wet, no trouble from bloating occurred. The precautions, as observed formerly were: (1) to give the cows a good feeding before they were first turned on the alfalfa; (2) to keep water and salt available in the paddocks all of the time, and (3) to keep the cows on the alfalfa constantly, except for milking time, regardless of weather. The alfalfa was safely grazed from May 17 to August 29, the duration of the experimental period, while the main herd likewise was on alfalfa pasture on through September and into October.

The alfalfa used was seeded in 1929 on a Fox sandy loam soil limed that season with seven yards per acre of marl and fertilized with 300 pounds per acre of 2-16-6. In 1930, the stand was top dressed with 300 pounds per acre of 0-10-10, and in the spring of 1932 another top dressing, this time 300 pounds per acre of 0-14-14 fertilizer was applied. The vigor and productivity of the alfalfa has improved each year, although a goodly part of the 1932 increase must be attributed to more and better distributed rainfall. The entire area was cut for hay in 1930 and was pastured in accordance with the plans of this experiment in 1931 and 1932.

Continuous Grazing

In 1931, the attempt to pasture alfalfa continuously from mid-spring throughout the summer was not entirely successful. Grazing was started too late that season, June 6, and, in holding down the number of cows to leave some summer feed, the alfalfa matured and became woody and lacking in nutritive value. As a result, grazing on this paddock had to be discontinued July 20 when it had furnished but 66 cow-days of pasture per acre.

The 1932 effort to secure continuous grazing gave much more satisfactory

[1]Pasture experiments are carried on at the W. K. Kellogg Farm of the Michigan State College cooperatively between the Division of Forage Crops and Diseases, Bureau of Plant Industry, United States Department of Agriculture, and the Section of Farm Crops of the Michigan Agricultural Experiment Station. Mr. Dorrance is Assistant Agronomist, Division of Forage Crops and Diseases.

The writers wish to acknowledge the advice and cooperation of C. M. McCrary, Superintendent of the W. K. Kellogg Farm, E. L. Anthony, Department of Dairy Husbandry, and C. E. Millar and G. M. Grantham, Department of Soils, Michigan State College.

Table 1.—Alfalfa pasture arrangement experiment.

Plot	Method of handling	Yield in 1930, pounds air dry hay per acre (1)	Yield, pounds of air dry hay per acre				Total cow days pasture per acre		Milk produced per acre while cows were on pasture		Value of milk testing 4 6%		Grain fed to cows on pasture		Cost of grain		Cash crop value of hay produced		Gross returns, i. e. cash value of hay per acre plus value of milk produced on pasture less cost of grain fed to cows on pasture	
			1931		1932															
			1st cutting	2nd cutting	1st cutting	2nd cutting	1931	1932	1931	1932	1931 at $1 25 per cwt	1932 at 22c. per lb. for butterfat	1931	1932	1931 at $1 29 per cwt	1932 at $1 00 per cwt	1931 at $12 00 per ton	1932 at $6.00 per ton	1931	1932
1	Continuous Grazing	1,950	Grazed	Grazed	Grazed	Grazed	66	142	2,224 lbs	4,033	$27 80	$40 81	556 lbs.	432 lbs.	$7.17	$4 32	.....	.....	$20.63	$36.49
2	Grazed 1 cutting; 2nd cutting for hay	1,377	Grazed	200	Grazed	1,931	78	77	2,717 lbs	2,409	$33 96	$24 37	679 lbs.	None	$8 76	00	$1 20	$5.79	$26.40	$30.16
3	1st cutting for hay; 2nd cutting grazed	1,289	2,600	Grazed	3,982	Grazed	30	111	1,087 lbs	2,920	$13 59	$29 55	271 lbs	730 lbs.	$3 50	$7.30	$15.60	$11 95	$25.69	$34.20
4	Harvested for hay 2 cuttings	1,206	2,190	411	3,589	2,510	.		.	.	.....	. .	.	. . .	.	.....	$15.61	$18 30	$15.61	$18.30

(1) All plots were cut once for hay in 1930 with no second cutting on account of drought and poor growth.

results. Grazing was started considerably earlier, May 17 rather than June 6, and the number of animals was adjusted from time to time to keep approximately an 8 to 10 inch growth of alfalfa available. The two-acre paddock, thus managed, carried four cows May 17 to June 16, two cows June 17 to July 19, three cows July 20 to August 1, and two cows from then to August 29. Thus this system yielded 142 cow-days of pasture per acre, an average carrying capacity of 1.37 cows per acre for the 104-day grazing period.

Pasturing the First Cutting

When alfalfa is needed for early pasture, it may be advisable, in some instances, to concentrate the herd on only a portion of a field so the balance may be cut for hay. Where harvesting the first cutting by grazing was tried, 78 cow-days of pasture were secured in 1931 and 77 in 1932. In 1932, by putting six cows on the two-acre paddock May 17, and by cutting to four on June 7, all available pasturage was cleaned up by June 14. It might have been better to reduce the number of cows so feed would have been available until July 1 when second cutting alfalfa was ready for grazing.

Harvesting the first cutting completely by grazing has at least one objectionable feature. The cows, unlike a mowing machine, are selective in their harvest and leave certain weeds grow. The second growth of alfalfa from this paddock contained considerable rag weed which materially lowered the quality of the 1931 pounds of hay cut per acre off this area August 3. After this mowing, the third growth came on as clean alfalfa.

Pasturing Second Cutting Alfalfa

Probably the system of alfalfa grazing used most frequently is that of grazing such second cutting alfalfa as may be needed for summer pasture after the first cutting has been removed for hay. In the dry summer of 1931, the second cutting alfalfa in this experiment yielded 30 cow-days per acre of excellent feed. In 1932, with more normal rainfall, growth of the alfalfa was much more luxuriant. On July 16, it was evident that the two cows turned on the two-acre paddock July 1 would not nearly harvest the alfalfa so four more were turned in for an 11-day period after which four cows were left in to complete the grazing by August 29. The second cutting in 1932 yielded a total of 111 cow-days of pasture per acre, an average carrying capacity of 1.89 cows per acre for a 59-day period.

From May 17 to June 30, inclusive, the cows produced an average of 30.9 pounds of milk per cow per day without grain. However, for the June 16-30 period, they had dropped to 25.4 pounds per cow daily so a 16 per cent protein ration was fed at the rate of one pound of grain per four pounds of milk. The average daily milk flow increased to 29.6 pounds per cow for the July 1-16 period and was 26.2 pounds for the grain feeding period July 1 to August 29. The drop as compared to spring production is doubtless due to the cows being that much farther along in their lactation period.

Pasturing Alfalfa Economically Sound

Data as to the value of pasturage and hay produced are given in Table 1 and are based on local hay and butterfat prices. Financial returns will, of course, vary in different communities with different cows and with differ-

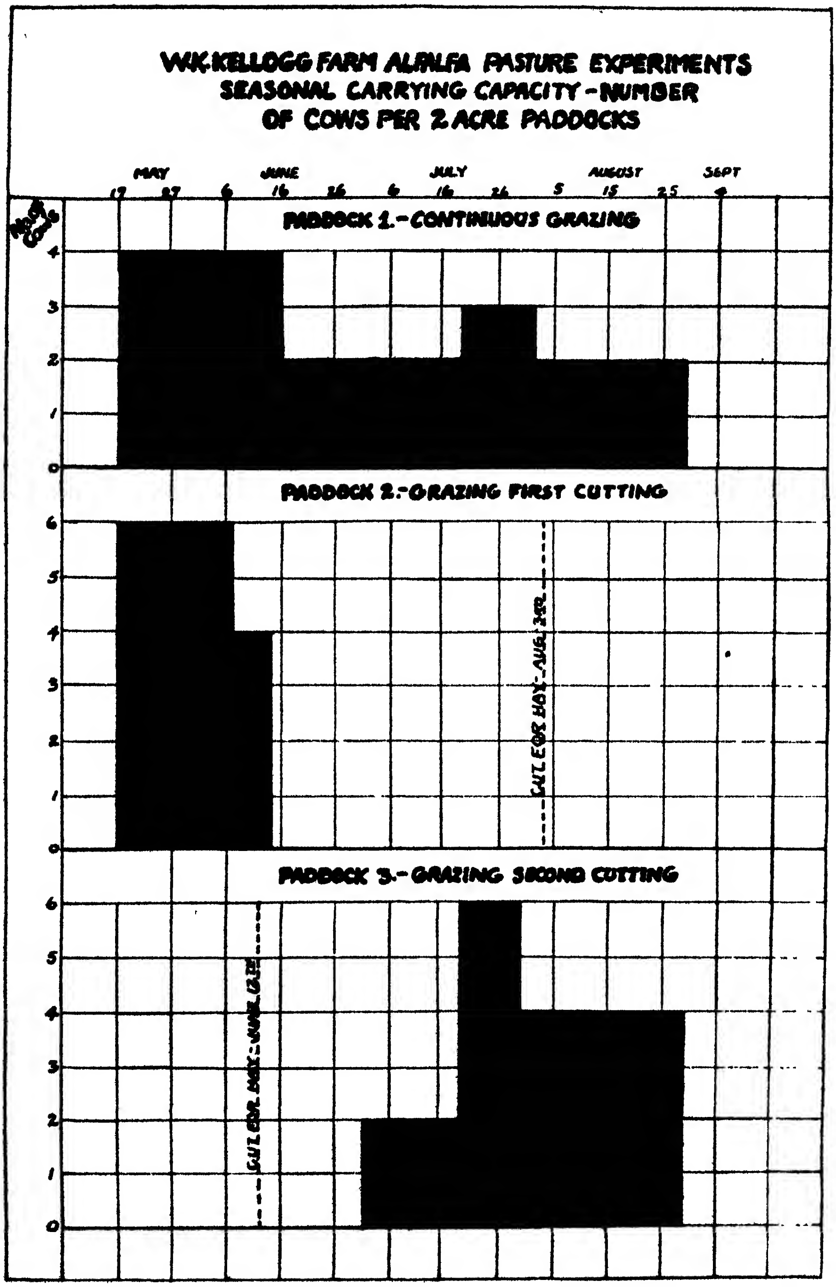

Fig. 1.—Chart of seasonal carrying capacity of the 2-acre alfalfa paddocks at the W. K. Kellogg Farm as grazed in 1932.

ent markets. Nevertheless, in this period of distressingly low prices, the growing of enough alfalfa so some of it may be used for pasture certainly warrants consideration. Here is a scheme whereby cows perform the labor of harvest and cows return much fertility back to the field from which it was taken. Here, these cows have paid, in one instance, a gross return of \$36.49 an acre for the entire crop, in another instance \$24.37 an acre for the first cutting, and in still another instance \$22.25 an acre for the second cutting of an acre from which a first crop of practically two tons per acre had already been cut for hay. With any favorable development in the market price of dairy products, much better financial returns from alfalfa pasture can be expected.

Table 2.—Spring and summer rainfall at the W. K. Kellogg Farm, 1930-1932.

(Precipitation in inches)

	April	May	June	July	August	September	Total Annual
Normal (1)......	2.57	3.69	4.08	3.16	2.94	3.14	34.28
1930.......... ..	1.54	3.68	2.65	1.22	1.50	0.76	20.81
1931............	1.13	2.14	3.68	0.70	2.05	2.46	24.69
1932............	1.45	5.03	3.98	4.11	2.83	2.13	37.56

(1) The mean precipitation at Kalamazoo, approximately 14 miles southwest of the W. K. Kellogg Farm, and of Battle Creek, about the same distance southeast, are taken as normal. Records have been kept at these places for 40 years.

The information of paramount significance is the carrying capacity and feeding value of the alfalfa pasture under good treatment on this naturally none too fertile sandy loam soil, in the rather unfavorable season of 1931 and the good season of 1932. In this particular project, no comparisons were made with other types of pasture, the object here being to determine the carrying capacity of alfalfa and to find out how it stands up under different types of grazing management. It is of interest to know, however, that grass pastures were practically non-productive on the W. K. Kellogg Farm during the period when second cutting alfalfa was yielding 111 cow-days pasturage per acre.[1]

In this experiment with the alfalfa being pastured to capacity in spring or summer, opportunity has been given it to recover root reserves by discontinuing grazing by September 1, thus permitting good fall growth. The alfalfa of all paddocks has thus gone into its fourth winter in apparently good condition. The heavily grazed paddocks are not quite as uniform in appearance as the one harvested strictly as a hay crop, but there is no present evidence to indicate that they will not furnish splendid grazing for some years to come. Even should grass encroach more rapidly than in the area harvested for hay, which condition is not yet evident, these pastured paddocks will still provide good pasture in addition to the excellent returns which they have already given.

[1]For a comparison of alfalfa with grass pastures on the W. K. Kellogg Farm as measured by grazing with sheep see Mich. Ag. Exp. Sta. Quart. Bul., Vol. XV, No. 2. Experiments With Permanent Pastures For Sheep.

It would appear from our work thus far, that the livestock or dairy farmer who wishes to pasture alfalfa can be something of an opportunist in his system of management, pasturing early if need be, pasturing continuously on certain areas if he can regulate the stock to keep the alfalfa in good feeding condition, or harvesting alfalfa for hay and pasturing subsequent growth as needed.

Table 3.—Fertilization of alfalfa paddocks.

1929—7 yards marl per acre applied prior to seeding. 300 pounds per acre 2-16-6 applied with seeding which was made with nurse crop of Spartan barley.

1930—300 pounds per acre 0-10-10 applied as top dressing after removal of 1st cutting for hay.

1931—None.

1932—300 pounds per acre 0-14-14 applied as top dressing in early spring.

Neither is it necessary to discontinue all alfalfa grazing by September 1. Hay fields which have already furnished two cuttings will, under most of Michigan conditions, have a third growth which may be pastured lightly in September and October and, if grazing is light enough so an eight-inch growth remains when winter sets in, there should be no serious injury to the stand.

SELECT ORCHARD SITES ON FERTILE SOILS, AVOIDING FROST POCKETS

N. L. PARTRIDGE AND J. O. VEATCH, SECTIONS OF HORTICULTURE AND SOILS

Local spring frosts cause losses in poorly located orchards and vineyards in Michigan. Frost injury occurs most frequently on relatively low ground surrounded by high ground. Most Michigan fruit growers are aware of the disadvantages of such sites and avoid them. Middle and higher positions on slopes, if unobstructed by woodlots, tend to be comparatively free from local spring frosts and have been thought best suited for orchard sites.

Nevertheless, orchard and vineyard sites should not be chosen from the single viewpoint of the relative infrequency of local frosts, although it is certain that frost pockets must be avoided. Fruit trees must make a vigorous, healthy growth if fruit production is to be large. Low-producing orchards are unable to return a profit, particularly during periods when prices are depressed. Much care should be given to the selection of soils of good fertility, so situated that the soil may be maintained with comparative ease, since it is much cheaper to produce fruit on the better soils which naturally produce more vigorous trees.

Comparative measurements of fruit tree growth have been made in many orchards, on the level uplands, the hillsides, and at the foot of slopes. Supplementary analyses of soil samples have been taken from the same series of stations on many of the more common soil types generally used for or-

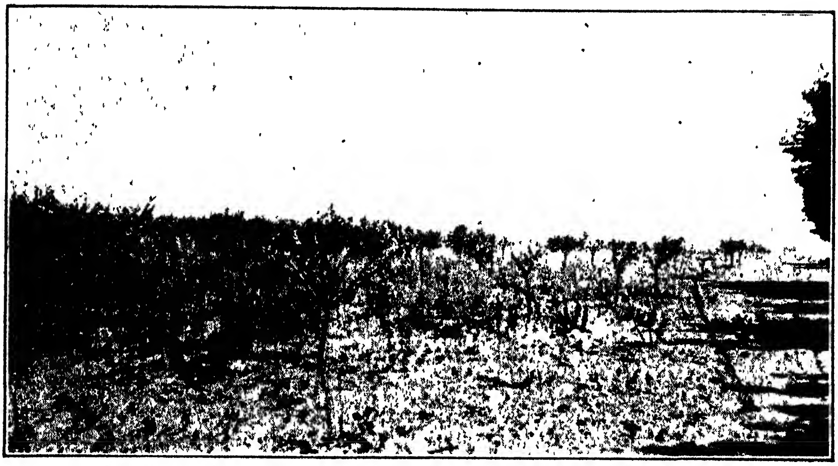

Fig. 1.—Cherry trees, 8 years old, on deep dry sand (Plainfield type). The soil is low in natural fertility and subject to blowing. (Photo by Veatch.)

chards. Although these studies have not been extended to all of the important soil types and although the number of studies made so far has been limited, the results have been so consistent, even on very diverse soils, that the most evident facts should be presented at this time.

Fruit tree growth has been largest at the foot of the slope where an accumulation of surface soil has been washed down from the hillside. The poorest tree growth has always been observed on the eroded hillsides. The trees set on the fairly level uplands have been intermediate in growth. This variation in fruit tree growth has been observed consistently on all

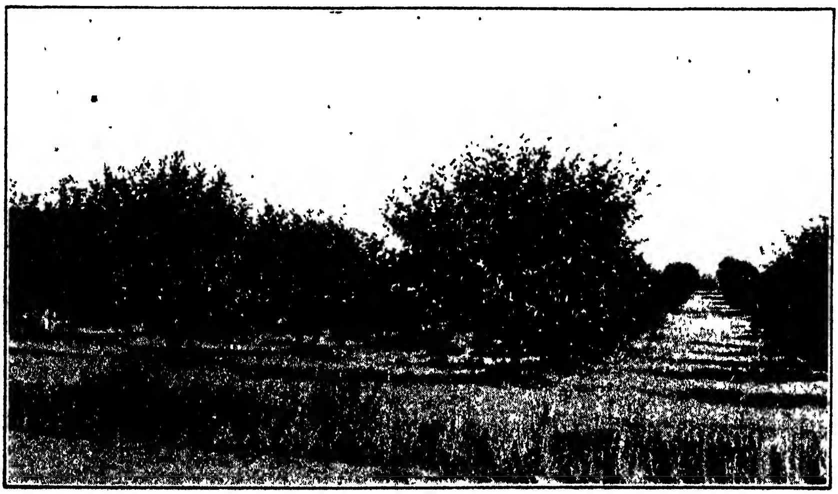

Fig. 2.—Cherry trees, 8 years old, on a well-drained sandy loam, underlain by clay. The soil is moderately fertile and easily cultivated; the surface is level or very gently sloping. (Photo by Veatch.)

the soils studied, whether sands or loams, and the analyses show these differences in growth are associated with differences in soil fertility. The amounts of the observed differences vary with different soil types.

The soils on the slopes tend to be of lower fertility than those of the valleys or uplands, even under virgin conditions, since there is a certain amount of erosion even under forest or grass cover. When the land is used for cultivated crops, the rate of erosion is increased. The loss of soil by erosion depends on the steepness of the slope, the character of the soil, and the climate. Loams of certain types are eroded most rapidly and, with equivalent conditions, the rate of erosion is probably more rapid in the southern part of the State than in the northern. Since most of the hillsides which have been set to fruit in Michigan have been used previously for cultivated crops, they are eroded and are low in fertility.

Vigorous fruit tree growth can be obtained on eroded hillsides only by the expenditure of much labor and the application of large amounts of fertilizers or other soil amendments. It is more difficult to retain the fertility of orchard soils on hillsides, even when uneroded previous to setting the trees, since the commercial fertilizers applied tend to wash down the slope rather than to enter the soil. A considerable percentage of Michigan orchards whose production costs per bushel are too high are on hillsides or in frost pockets. It should be emphasized that the frostiness of much of the low ground prevents the profitable production of fruit on sites at the foot of slopes despite the greater soil fertility characteristic of such locations.

Uplands do not have as fertile soils as those at the foot of slopes, but this defect is more than counterbalanced in most instances by the relative freedom from local frosts on the higher sites. If the upland is very extensive, the better orchard locations are near the edges of the area, where air drainage is better.

There is a considerable difference in the value of different soils for orchard use. As has been mentioned, the study of soils from the point of view of their suitability to fruit growing is not complete. Nevertheless, it is possible now to point out that deep dry sands seldom produce the vigorous tree growth essential to productiveness in fruit trees. The more friable loam soils and the well-drained sandy soils underlain by clay seem to be much more suitable.

REPAIRING OF STORM DAMAGED TREES

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The ice and sleet storm in central Michigan on March 20, 1933, caused a tremendous amount of injury to many fine shade trees. At East Lansing, the ice on small twigs measured an inch in thickness. This amount of ice added so much weight to the branches and crown of the tree that in many cases the branches could not hold up under the load and were broken or entirely severed from the tree.

Certain species of trees seemed more susceptible to injury than others. In the Lansing area, the species most damaged by the storm were box elder

(Acer negundo), poplar (Populus sp.), American elm (Ulmus American), Chinese elm (Ulmus Pumila), and willow (Salix sp.). The oaks (Quercus sp.), hard maples (Acer sp.), hackberry (Celtis occidentalis), and beech (Fagus grandifolia) seemed to show less storm damage.

Many of the injuries caused by this storm are small and the owners of the trees will have a tendency to underrate their seriousness. Every broken limb and every wound that penetrates as far as the inner bark may become the entrance point for insects and disease unless these injuries are properly treated. The best and most economical means of preventing future extensive decay is to attend to each injury as soon as it occurs. Decay allowed to continue unchecked will in time lead to disfigurement and premature death of the tree. The longer wounds are neglected the more expensive and complicated is the job of repair. If the injury is treated as soon as it occurs, the work is usually simple and comparatively inexpensive.

Many of the broken crotches had already been weakened by rot. However, there were cases where the sheer weight of the ice broke healthy branches which showed no signs of previous weakening due to disease or insects. In trees that have been properly trimmed and cared for, the ice damage was rather light in comparison to those trees that had been neglected. Trees, like human beings, should be given an examination at regular intervals and the repairs needed made at these times. In cases where the trees have been severely damaged, the owner should consider whether he is justified in spending the necessary money on extensive repair work. In many cases, these trees will be poor, misshapen specimens so weakened that the rest of the top is likely to break with the next wind or sleet storm. In such cases, the money spent in repair work could be better invested in the transplanting of a new, healthy, well-shaped tree to take the place of the damaged one.

In tree repair work, the first operation should be that of the removal of injured branches and of others that are likely to be damaged in the next wind or sleet storm. The broken hanging branches should be removed as soon as possible, as they are a menace to life and property. A small limb dropping from a great height can do considerable damage. All broken branches should be cut back to the nearest good crotch. In the removal of branches, the cuts should be made as close to the remaining portions of the tree as possible. Never leave a stub protruding from the remaining portion of the limb. These stubs die, and rot soon sets in which travels back into the heartwood of the tree. The entrance of rot through stubs is one of the commonest sources of infection in shade trees and, if it is allowed to continue, it produces a thin hollow-shelled tree.

Large limbs should not be removed with a single cut, as this usually strips the bark and wood as the limb falls. A preliminary cut should be made on the under side of the limb about a foot from where the final cut is to be made. This cut should extend about one-fourth to one-half the way through the limb, depending upon when the saw tightens. A second cut should be made on the upper side of the limb an inch in front or behind the first cut. This cut should continue until the limb falls. The third cut is made to remove the stub and should be made as close as possible to the remaining portions of the tree, so that the final cut is flush with the remaining portion of the tree, leaving no projection or stub.

All final cuts should be made so that they will shed and not hold water. The first and second cuts on small limbs can be eliminated when the weight at the limb can be supported in the hand. If the branch to be removed has

already been split and broken, the limb should be removed as carefully to prevent further damage. The stub should be removed, and the healing surface left as smooth as possible. All the injured portions of the tree should be removed. Then the splintered area should be made as smooth as possible with a chisel or gouge. The bottom and top of the wound should be pointed to facilitate rapid healing and should be so shaped that water will drain out. It is well to remember that the length of the wound up and down the tree means little in the length of time it takes the wound to heal, but that it is important to keep the width of the wound down as narrow as possible. The cambium layer or healing-over tissue is produced in the greatest quantity on the sides of the wound and in a less degree at the top and bottom and, therefore, the sides heal over fastest.

All cut surfaces should be made water-proof through the use of a wound dressing. There are many commercial wound dressings on the market today which can be purchased in paint and hardware stores. Asphalt paint makes a very good dark-colored wound dressing and can be easily applied with a common paint brush. The wound should be repainted as needed until completely healed over.

In some cases storm damaged trees are being topped, i. e., cutting tops out of large trees and leaving nothing but the trunk with a few very large stubs. Under ordinary circumstances, trees should never be topped. Trees so abused are often dead in a few years, and those mutilated specimens that do survive have small compact tops composed of weak shoots that break in wind and

sleet storms, leaving an entrance point for both insects and diseases. Such trees do not present the natural appearance of a tree, but rather present grotesque forms that are not pleasing in appearance. Successful tree trimming accentuates rather than disguises the natural form of the tree.

Tree trimming in large trees is a dangerous task and every precaution should be taken to insure the safety of the worker. If a ladder is to be used when he is working alone, the top should be lashed to the tree so that there is no danger of its slipping or turning. The tree worker should be particularly careful in species that have brash and brittle wood, as do the poplar and willow. Special care should also be taken when climbing on dead, diseased, or insect-infested limbs, as they are likely to look strong yet break under little weight. Caution should be exercised in working near over-head wires, as they often carry heavy charges of electricity. The best policy for any tree worker is to be on the alert at all times.

Large spreading trees, such as the American elm, often suffer severely in heavy sleet storms because of the accumulated weight of the ice on the tops. As the ice accumulates the weight spreads the branches out, and as they spread out more ice accumulates, placing more weight and strain on the crotches. If enough ice forms, the weight splits down the crotch or completely severs the limb from the tree. The farther the branches spread, the more lateral pressure is exerted and the more likelihood that it will split the crotch. If the limbs can be held in a more or less upright position, more weight can be carried and the chance of splitting the crotch is lessened. In some cases splitting may be slight and apparently cause no serious damage. However, this slight split may so weaken the crotch that the next high wind or sleet storm will break the limb and thus cause more injury than if the limb was completely removed by proper tree trimming. Crotches so injured and others that are likely to split in the future should be repaired and strengthened by bracing.

The best method of bracing large limbs is to place the bracing material high up in the limbs above the weakened crotch. The higher the bracing

the smaller the size and lower the cost of the bracing, and the more effective it will be in keeping the limbs in their natural position. Holes should be drilled through the limbs to be strengthened, and eye bolts and washers should be counter-sunk flush with the bark so that the cambium layers of the tree will soon cover them up and there will be no traces of the injury or an entrance point for insects and disease. From these eye-bolts strands of heavy non-rusting wire should be strung. A turn-buckle can then be made by inserting a stick between the strand and twisting this around and around. This will draw the limbs up closer together and into the desired position. If the limbs are very heavy, a block and tackle can be used to draw the limbs up to their proper location and then the wire tightened and the block and tackle removed.

An old method of bracing and one that is still used in some cases was to place loops of wire or bands of steel completely around each branch and then tighten up the wire connecting these bands. This method caused a great deal of injury to the tree because the wire or band cuts through the bark and the cambium layer, preventing the normal flow of sap. This method of bracing should never be used. Other common faults in bracing are that the material used is not heavy enough to stand a sudden strain, and that it is not placed far enough above the crotch to give satisfactory support to the entire limb.

When large limbs are involved, eye-bolts should be at least an inch in diameter with a four-inch washer. Lag screws are sometimes used in place of eye-bolts. This is a rather poor practice, except with small limbs, as they are likely to pull out. The eye-bolts should always be of the very best quality, as they often prove the weakest point in the brace. In any system of tree bracing the best mechanical principles should be employed and a careful estimate of the load to be carried should be calculated. The larger the angle of the limb from the main trunk the greater the load, and the nearer the cable is placed to the crotch, the heavier the load. The amount of strain to be overcome in tree bracing is very frequently underestimated.

Sleet Storm Damage

In such cases the expenditure for tree repair should be well considered. It may be better economy to replace the damaged tree with a small healthy specimen.

PRELIMINARY RESULTS IN ERADICATING WEEDS WITH ZINC SULPHATE AND BY BURNING IN FOREST NURSERY SEED BEDS

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Eradication of weeds in forest nursery seed beds by hand weeding has proved so costly that other means of eradication have been developed in recent years. In Scotland, burning over the surface of the seed beds with a blow-torch just prior to the germination of the forest tree seeds has proved successful and has materially reduced the cost of weed eradication. (1)

This method is practical because the weed seeds germinate sooner than the forest tree seeds. Therefore, a large number of the weeds are above ground when the burning is done. These are destroyed by the burning process. Kummel in an unpublished manuscript reports variable success at the Wind River Nursery in Washington by the method developed by Duthie in Scotland. The chief drawback there was the difficulty experienced with wet weather which is characteristic of the germinating season. Only during the drier seasons was burning entirely successful.

Recently, Wahlenberg (2) worked with various chemicals for weed control at the Savenac Forest Nursery in Montana. Zinc sulphate used at a rate of eight grams dissolved in 250 cubic centimeters of water per square foot of seed bed area gave the most satisfactory results. This treatment reduced the cost of producing 2-0 seedlings by 38 cents per bed of 48 square feet. It gave such all around satisfaction that the eradication of weeds by the use of zinc sulphate is the standard method of weed eradication in this nursery.

A difficult weed problem had existed at the Michigan State College nursery for a number of years. The results secured by Wahlenberg using zinc sulphate and by Duthie in burning over seed beds appeared so promising that a series of tests using both methods was inaugurated to work out the details of application for the local nursery.

A series of small scale tests was initiated in the spring of 1930 for the primary purpose of determining which treatments showed the greatest promise for application on a larger scale. A series of larger scale tests was developed in the spring of 1931 to determine the relative costs of hand weeding, chemical eradication, and burning.

Method of Study

The 1930 experiment consisted of a series of plots, each one by two feet in size. Twenty plots were in the chemical series and twenty-four were in the burning series. Sterilized soil was used in the plots in order to reduce complications with natural weeds to a minimum. The effectiveness of the sterilization is indicated by a comparison of the germination of miscellaneous weed seeds in the sterilized soil with that in the untreated nursery soil. On equal areas of soil, 10 miscellaneous weeds germinated in the sterilized soil as compared to 72 in the natural soil.

The method of testing the different chemical solutions was the same as that used by Wahlenberg (2). Bottomless wooden containers one by two feet by eight inches were sunk into the ground. A layer of sterilized soil three inches deep was placed in each container. One large bed four by twelve feet was used for the burning experiment. This was surrounded by a frame sunk into the ground. The bed was then divided into individual plots one by two feet in size.

In each plot, 200 seeds of white spruce, sorrel, rag-weed, and pepper grass were sown. The seeds were sown in drills, the spruce at a depth of one-fourth inch and the weeds at a depth of one-eighth inch. To insure uniform depth of sowing, the drills were made by a specially constructed board. Immediately following the sowing, 16 plots were treated with 12, 10, 8, and 6 gr. solution of zinc sulphate per square foot respectively, four plots being treated with each solution. Four plots were left untreated. The frames were then covered with muslin and screening to prevent the entrance of rodents and foreign weeds from the outside.

The plots which were to be burned over were sown and screened in the same manner as the chemically treated plots. No burning was done at the time of sowing. One group of plots was burned seven days after the sowing, and the other, 14 days after the sowing. The burning was done for 4, 8, and 12 seconds respectively per square foot. A Hawk fire gun was used to do the burning. At the time the second series was burned, the soil was cracking in some spots where the tree seedlings were on the verge of bursting above ground.

Results

Zinc Sulphate Treatment:

A record was kept of the germination and survival of all seeds sown. All species had apparently completed their germination early in the summer, but the sorrel showed a secondary period of germination early in September. The results given in Tables 1 and 2 are based on germination, and survival up to August 9. The germination which took place after that date is presented in Table 3.

Table 1.—The total germination to August 9, of white spruce, sorrel, pepper grass and ragweed expressed in per cent of seed sown.

Treatment	Species			
	White Spruce	Sorrel	Pepper Grass	Ragweed
	Germination Per Cent			
Check	49 5	48.0	44 0	23 0
6 gr. $ZnSO_4$	44.5	7 0	15 0	4.0
8 gr. $ZnSO_4$	48 5	0 25	11.0	3.5
10 gr. $ZnSO_4$	35 0	3.50	3 0	5 0
12 gr. $ZnSO_4$	26.5	4.50	10.5	1.5

That any strength solution of zinc sulphate is effective in reducing the germination of weed seeds is shown by Table 1. Except for minor inconsistencies, the strength of the solution is inversely correlated with the percentage of germination of the seeds. The germination of the white spruce responded differently to the zinc sulphate treatment than did the weed seeds. Solutions up to eight grams per square foot had no noticeable effect on the germination of the tree seeds. Any strength solution greatly reduced the

Table 2.—The survival of white spruce, sorrel, pepper grass, and ragweed expressed in per cent of germination.

Treatment	Species			
	White Spruce	Sorrel	Pepper Grass	Ragweed
	Percentage Survival			
Check	25 3	100	100	100
6 gr. $ZnSO_4$	42.7	78.6	73.3	62.5
8 gr. $ZnSO_4$	80.4	0.0	36.4	85.7
10 gr. $ZnSO_4$	88.6	85.8	66.6	70.0
12 gr. $ZnSO_4$	84.9	55.6	23.8	100.0

per cent of germination of the weeds. Based on satisfactory germination of white spruce and fairly complete elimination of weed seed germination, the eight gram solution gave the best results. The survival on the plots is shown in Table 2.

There is no general trend with regard to survival. In the case of the white spruce, the low survival on the check plot and the plot treated with six gr. $ZnSO_4$ solution, is due to the dense weed growth which choked out the tree seedlings. Survival of weeds apparently was not affected by the $ZnSO_4$ treatment, the results are too erratic to bring out any principle. Thriftiness of the individual plants probably was more important than any other factor.

A secondary period of germination took place early in September. This germination was confined to the weed seeds, especially the sorrel. Unfortunately, the check plots were disturbed before this time so that no figures are available on these for comparison with the treated plots. This delayed germination, especially of the sorrel, may be characteristic of the species or it may have been caused by the zinc sulphate treatment. Table 3 shows the germination which took place early in September.

Table 3.—The germination of sorrel, pepper grass, and ragweed in early September, expressed in per cent of seed sown.

Treatment	Species		
	Sorrel	Pepper Grass	Ragweed
	Germination Per Cent		
6 gr. $ZnSO_4$	7 0	2 5	0.5
8 gr. $ZnSO_4$	10 0	1 0	0 5
10 gr. $ZnSO_4$	7.0	1 0	0.5
12 gr. $ZnSO_4$	5 5	1.0	0.5

In the spring of the second season, both live and dead weeds were removed from all plots to prevent further interference with the tree seedlings. Survival of the white spruce at the end of the second season was uniformly high on all plots. There was no noticeable effect of the chemical on the white spruce seedlings.

Burning over seedbeds:

Records on the burned plots were kept in the same way as those for the chemically treated plots. The summary of these data is presented in Table 4.

Analysis of Table 4 suggests that two factors govern the effectiveness of burning; (1) the time at which the burning is done and (2) the length of time the burning is applied. The former is particularly important.

The total germination of the weed seeds, before and after burning, is approximately the same for all burning applications as well as the check plot. This indicates that only the germinated seed is affected by the burning. Since the seed, which has not pushed itself above ground is not affected, postponement of the burning to as late a date as possible is necessary if a maximum number of weeds are to be destroyed. This is illustrated by the "germination after burning," as well as the "germination in 7 and 14 days," shown in Table 4. The germination of the weed seeds at the end of seven

Table 4.—The rate of germination of weed and tree seeds and the effect of different degrees of burning at 7 and 14 days after sowing.

Treatment	Germination in 7 days				Germination in 14 days				Total Germination				Germination after Burning				Survival of White Spruce at End of Season
	White Spruce	Sorrel	Pepper Grass	Ragweed	White Spruce	Sorrel	Pepper Grass	Ragweed	White Spruce	Sorrel	Pepper Grass	Ragweed	White Spruce	Sorrel	Pepper Grass	Ragweed	
	Germination Expressed in Per cent of Seed																Expressed in Per cent of Germination
Check Plot	0	6.5	6.5	0.0	0	20.5	14.0	2.5	37.0	22.5	19 0	6.5	......	......	......	......	39.2
Burned 7 days after sowing.																	
4 Sec. burning	0	6.5	1.5	0.0	0	17.0	9.0	3.0	47.5	23.5	12.0	7.5	47.5	17.0	10.5	7.5	76.5
8 Sec. burning	0	10.5	2.0	1.0	0	14.0	15.0	3.0	45.0	24.5	16.0	11.5	45.0	14.0	15.0	10.5	83.3
12 Sec. burning	0	7.5	2.0	0.5	0	11.0	10.5	3.5	36.0	19.5	20.0	10.0	36.0	12.0	18.0	9.5	48.6
Burned 14 days after sowing.																	
4 Sec. burning	0	6.0	6.0	0.5	0	18.5	17.0	3.0	42.0	25.0	25.0	11.0	42.0	6.5	8.0	8.0	89.3
8 Sec. burning	0	7.5	4.5	0.0	0	29.5	10.5	4.0	35.5	35 5	15.5	12.0	35.5	6.0	5.0	8.0	71.8
12 Sec. burning	0	6.0	8.5	0.5	0	24.0	21.5	7.0	31.5	27.5	27.5	15.5	31.5	3.5	6.0	8.5	87.3

days was on the average from one-half to one-third as great as at the end of 14 days. In the case of rag-weed, a large seeded species of weed which germinates very slowly, the burning is not at all effective.

The raising and cracking of the soil where the white spruce was sown indicated that germination was in an advanced stage the fourteenth day after sowing the seed. No burning could be done later than this, therefore, without injury to the white spruce seedlings. The time required for the seed to germinate will vary considerably, depending on the weather conditions that prevail after the sowing. It is necessary, therefore, to watch the seedbeds very closely in order to accomplish the burning just prior to the appearance of the seedlings above ground. The success of the burning depends on it.

The intensity of the burning is important only up to a certain point in destroying the small plants. A four-second burning requires such rapid movement of the blow torch over the seedbed that occasional small spots of the bed are missed. This, of course, results in a small per cent of survival of the weeds which germinated prior to the burning. Both the 8 and the 12 second burnings are sufficiently long thoroughly to cover the seedbed and destroy all the weeds that are above ground. There is little or no difference in the effectiveness of the 8 and the 12 second burnings in killing weeds. The data indicate, however, that the 12-second burning may have been slightly injurious to the germination of the white spruce. This could easily be the case in that the tender spruce seedlings about to burst through the soil were scorched. The 8-second burning just prior to the germination of the white spruce is the safest and most effective.

Comparative Costs of Weed Eradication

In the spring of 1931, three plots were established to determine the relative costs of hand weeding, chemical treatment, and burning as means of eradicating weeds. Three plots of equal size, 48 x 4 feet, were used. One plot was not treated, all of the weeding on it was done by hand. The second plot was treated immediately after the seed was sown with zinc sulphate at a rate of eight grams per square foot. The third plot was burned over with a blow torch 13 days after the seed was sown. At this time, the soil was breaking on the surface in a number of spots throughout the seedbed, indicating that the seedlings would be above ground within a few days. In burning the surface of this seedbed, the blow torch was passed over the surface at such a rate that all of the visible weeds were scorched. This speed was equivalent to approximately five seconds per square foot, which was somewhat less intensive than the 8-second burning which gave satisfactory results on the small scale plots.

Since neither the chemical treatment nor burning the soil surface completely eliminated all weeds, both of these plots were hand-weeded whenever necessary. A record was kept of the actual time involved in each of the operations and the time converted into cost at a rate of 30c per hour. The time required for hand-weeding on the basis of a 12 x 4 foot seedbed was as follows for the different plots:

Untreated	
1st season	102 minutes
2nd season	52 minutes
Total	154 minutes
Chemically treated	
1st season	31 minutes
2nd season	56 minutes
Total	87 minutes
Burned	
1st season	47 minutes
2nd season	33 minutes
Total	80 minutes

It is obvious from the foregoing that both the chemical treatment and burning the surface of the seedbed were effective in reducing the amount of hand-weeding during the first season. The shorter time required to weed the burned plot during the second season cannot be attributed to the effects of burning since the effect of burning could not possibly carry over to the second year. It must be due to the difference in quantity of weeds on the individual plots.

The costs of each method for the two seasons are given below, on the basis of a seed-bed, 4 x 12 feet.

Untreated	
Cost of hand-weeding	\$0.77
Chemically treated	
Cost of $ZnSO_4$ @ 18c per lb..............	\$0.15
Cost of mixing and applying solution.......	0.03
Cost of hand-weeding	0.45
	\$0.63
Burning	
Cost of fuel and burning	\$0.03
Cost of hand-weeding	0.40
	\$0.43

The burning proved to be the cheapest method of weed eradication, and the chemical treatment was second in cost, while complete hand-weeding was the most expensive. The cost of subsequent hand-weeding of the chemically-treated plot is much higher than that reported by Wahlenberg (2). He reports the cost for this operation at 6c per 48 square feet.

Discussion of Results

From the standpoint of effectiveness in killing a maximum number of weeds, and preventing any damage to tree seedlings, the 8-gram zinc sulphate solution and 8-second burning per square foot just before germination of

the tree seeds were most satisfactory. In connection with the burning method, a definite length of burning is not essential, as this will vary with the abundance of weeds, however, the experiment indicated that a minimum of five seconds per square foot was necessary to effectively kill all weeds. Burning should be postponed until there is evidence that the seedlings are on the verge of bursting above ground. With the species used in this experiment, a maximum period of 14 days elapsed between sowing and germination of the seed. In the case of fall-sown seed-beds, it would probably be necessary to watch the seed-beds rather carefully in the spring as soon as weather conditions become favorable for germination.

Although the results of this test showed burning to be a cheaper method of weed eradication than chemical treatment, it is likely that the cost of the latter method could be reduced on larger scale application by buying zinc sulphate in large quantity and using mechanical methods of application. The burning method possibly has an advantage over the chemical treatment in its effect on the soil. The continued use of zinc sulphate will tend to increase soil acidity, which, unless guarded against, might react unfavorably on the soil. Whether or not burning continued over a period of years has any beneficial or detrimental effect on the soil has not been determined.

Either the chemical treatment or burning of the surface of the seed-bed has a greater advantage over complete hand-weeding than the costs alone indicate. Both methods eliminate the heaviest weedings which occur during the first few weeks of the life of the seedlings when they are least able to withstand disturbance.

The results of these tests suggest only tentative conclusions. Application of the treatments to larger areas and to several tree species will be necessary before final conclusions can be drawn.

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MAKING SPRUCE-FIR LAND PROFITABLE

Removal of Competing Hardwoods Often Necessary to Insure Growth of Pulpwood

R. H. WESTVELD, SECTION OF FORESTRY

Several tree species are commonly associated with spruce and fir on pulpwood land. The more common associates include aspen, paper birch, Balm of Gilead, northern white cedar, and tamarack. Under certain conditions, these species may greatly outnumber the spruce and fir, while elsewhere

the latter species predominate. The extent to which the associated species enter into the composition of the stand depends on the soil or past treatment of the area. A severe cutting or fire is usually followed by a decided increase of aspen and paper birch, or, on certain sites, of Balm of Gilead. Frequently, these species reclothe the denuded land with a heavy cover of tree growth immediately after denudation. Spruce and fir may seed in a few years later; but, by that time, the aspen, paper birch, and Balm of Gilead, because of their rapid growth in height and extensive root development, have attained such large size that they seriously retard the development of the conifers. Even where all species become established at the same time, the spruce and fir are handicapped because of their very slow growth during the first few years of life. On the other hand, aspen grows rapidly from the start. It is not uncommon for aspen to make an average height growth of two feet per year, for the first 10 years at least, while spruce and fir seedlings are rarely over six inches high at the end of the third year.

In Michigan, a wide variety of second growth spruce-fir forests are to be found. Practically all of these stands have grown up without any attention from the owner. However, if he realized that his land might be producing a crop of worthless or low value trees instead of valuable pulpwood species, he probably would give more attention to his forest crop. Some areas develop satisfactorily without any attention, but a large proportion of them do not. The following discussion deals with the two types of second growth spruce-fir forests that occur in northern Michigan.

Comparison of Two Spruce-Fir Forests

Tables 1 and 2 present data secured on one-fourth acre plots on two areas of spruce-fir forest which developed under different conditions. The sites on which these stands occur are similar. On area I, the spruce and fir became established and grew up without any interference from hardwoods. On area II, a dense stand of aspen and paper birch with a small quantity of spruce and fir became established at the same time. Then additional spruce and fir became established in the stand during the following 10 years. The average age of the older trees on area I is 50 years, while that of area II is 45 years.

The extent to which the spruce and fir on area II were suppressed by the aspen and paper birch is indicated in Table 1. Growth of the conifers in

Table 1.—The growth and development of spruce-fir forests under two different forest conditions.

Species	Area I	Area II	Area I	Area II	Area I	Area II
	Average Diameter—Inches		Average Height—Feet		Diameter Growth Last Decade—Inches	
Black Spruce	4.6	1.7	33	13	0.9	0.4
White Spruce	....	1.8	....	14	....	0.5
Balsam Fir	3.5	1.9	25	14	1.2	0.7
Aspen	....	5.2	....	50	....	1.8
Paper Birch	....	4.2	....	47	....	0.7

Table 2.—The distribution of species by diameter classes in two spruce-fir forests.

Diameter	Black Spruce Area I	Black Spruce Area II	White Spruce Area I	White Spruce Area II	Balsam Fir Area I	Balsam Fir Area II	Aspen Area I	Aspen Area II	Paper Birch Area I	Paper Birch Area II	Other Hardwoods Area I	Other Hardwoods Area II
	Number of trees per acre											
1..........	30	30	0	70	0	500	0	0	0	240	0	20
2..........	140	60	0	0	0	390	10	40	0	460	0	60
3..........	160	0	0	0	10	100	0	50	0	220	0	0
4..........	240	0	0	10	10	40	0	70	0	130	0	10
5..........	240	0	0	0	0	20	0	60	0	90	0	20
6..........	170	0	0	0	0	0	0	20	0	60	0	0
7..........	90	0	0	0	0	0	0	10	0	0	0	10
8..........	20	0	0	0	0	0	0	0	0	0	0	0
9..........	10	0	0	0	0	0	0	0	0	0	0	0
Total.....	1,100	90	0	80	20	1,050	10	250	0	1,200	0	120

diameter and height is much slower on area II than on area I. The large size of the aspen and paper birch, both in diameter and height, on area II shows the rapid growth that these species make.

Trees below five inches in diameter cannot be utilized advantageously for pulpwood. Therefore, the number of trees above this diameter, as shown in Table 2, is of interest in showing the marked difference in the two areas for pulpwood production. On area I, where the spruce and fir was not hindered in its development by over-topping aspen and paper birch, there are 530 trees per acre large enough for pulpwood. Area II has only 20 trees per acre of pulpwood size and 270 hardwoods large enough for cord wood. The volume of pulpwood on area I is 20.7 cords. The volume of cord wood on area II is 20.2 cords. In other words, in approximately the same length of time, the former area has produced a crop worth at present prices, at least $100 and the latter area a crop worth approximately $30. In many localities, it would be difficult to market the aspen and paper birch for any price and, under such circumstances, the latter area would have little or no value.

Cutting to Increase Growth on Remaining Trees

The foregoing data suggest the importance of providing favorable conditions for the growth of the most valuable species if timber-growing is to be profitable. It is apparent that these favorable conditions should be created at an early age, in order that the benefit of such operations may be secured over a long period of time.

It is interesting to note the large number of small spruce and fir on area II. Enough trees exist there under the canopy of the aspen and paper birch to produce a fully stocked stand of pulpwood. If the hardwoods on this area had been removed or girdled at an early age, the pulpwood production would have been greatly increased. However, this area can still be made to produce a good crop of pulpwood by releasing the spruce and fir. This can be done either by cutting or girdling the trees. The latter practice would be followed where no market could be found for the aspen and paper birch.

If this material can be marketed for fuel wood, an income is realized on the operation. At the same time, a good stand of spruce and fir is insured for the future.

Experiments in the East, where similar spruce-fir forests occur, have shown that the small spruce and fir respond very quickly to the favorable growing conditions created by the removal of the hardwoods and make rapid growth, frequently from three to five times as much growth as prior to the removal of the hardwoods.[1] Although data on the effect of such operations are not available for Michigan, it is reasonable to believe that a similar increase in growth will take place here.

The treatment of areas similar to area II is advisable in order to increase the value of such stands in the future, and the time to begin stand improvement is when the trees are still young. Early cuttings will prevent the loss of much valuable growth on the spruce and fir. This work can be carried on most advantageously between the fifth and tenth years. By that time the spruce and fir are large enough to make good growth if freed from competing hardwoods. Recent experiments at the Dunbar Forest Experiment Station indicate that the spruce and fir respond best when the hardwoods are removed in two cuttings, the second cutting being made two or three years after the first. In some cases, the aspen and birch will sprout freely after cutting and may overtake the conifers in three to five years. If this occurs, the second cutting of the hardwoods will be necessary. The cost of such operations at the Dunbar Station has varied from $1.50 to approximately $5.00 pe racre.[2] The cost on any area depends on the amount of hardwoods present and the number of cuttings that must be made. Such expenditures are easily justified in view of the decided increase in value which takes place after such cultural operations.

RECENT PROGRESS IN BREEDING BORER RESISTANT CORN

A. R. MARSTON, SECTION OF FARM CROPS

The breeding of strains of corn which show a marked resistance to attack by the European corn borer has been a promising development in work conducted at the Michigan State College Corn Borer Sub-station near Monroe.

Maize Amargo, a low-yielding South American corn unsuited to Michigan but evincing distinct resistance to European corn borer attack, was crossed in 1926 with native Michigan corn varieties in an effort to secure productive and adapted strains of dent corn which would be characterized by this same resistance. That pure Maize Amargo still is resistant to the borer's ravages is indicated by its low infestation in recent years as compared to that of native Michigan varieties of dent corn, Table 1.

[1]"Suggestions For the Management of Spruce Stands in the Northeast," M. Westveld, United States Department of Agriculture Circular No. 134, 1930, page 16.

[2]Data contributed by P. W. Robbins, Research Assistant, charge of the Station.

Table 1.—Comparison of number of borers to 100 plants in pure Maize Amargo and native corn.

	1930	1931	1932
Pure Maize Amargo....	2.0	7.4	5.7
Check—Native Corn	19 0	44.7	53 8

The progeny of these crosses between native corn and Maize Amargo have been inbred and selected for corn borer resistance for several years. It has been contended that the low borer infestation of these Maize-Amargo x Native Corn crosses has been due to the lack of vigor which has naturally resulted from this inbreeding. However, crosses between native corns have been similarly inbred for the same period of time and, although these inbreds do have a smaller borer infestation than normally vigorous open-pollinated corn, their borer population has been consistently and materially greater than similar inbreds carrying Maize Amargo parentage, Table 2.

Table 2.—Comparison of number of borers to 100 plants in inbreds of native corn x Maize Amargo and native corn x native corn.

	1930		1931		1932	
	F_3	F_4	F_4	F_5	F_5	F_6
Inbreds Native Corn x Maize Amargo....	6.0	3 0	14.4	12.2	9.4·	8.3
Inbreds Native Corn x Native Corn....	10.0	12.0	26.6	23.1	21.8	26.1

Corn breeders have definitely established that the breeding together of the right two inbred lines, or the favorable combination of several inbred lines produces corn of marked thriftiness in the first generation. Such thrift, where secured, is known as hybrid vigor.

In this work, in order to regain vigor which had been lost in the inbreeding process, such inbreds with Maize Amargo parentage which had shown highest borer resistance over several years were bred together to secure hybrid vigor. Single crosses, double crosses, and the blending of the pollen of several inbred strains to secure what may be termed a synthetic strain or variety, have been made. These were compared with hybrid corns from several of the mid-western experiment stations (Table 3) and all strains containing Maize Amargo breeding had a much lower borer infestation than those made up strictly of native corns.

The crossing or blending of the various inbreds was successful in bringing back vigor and productivity in most instances, yet, even though the strains crossed with Maize Amargo were fully as vigorous as the straight native corns, they contained, on the average, less than 50 per cent as many borers.

Table 3.—Comparison of corn strains tested for number of corn borers per 100 Plants, 1932.

	Number Borers Per 100 Plants
Pure Maize Amargo Inbreds	5.7
Pure Maize Amargo Synthetics	11.4
Single Crosses (Native Corn x Maize Amargo Inbreds)	16.7
Synthetic Lines (Native Corn x Maize Amargo Inbreds)	20.4
Synthetic Lines (Native Corn x Native Corn Inbreds)	43.3
Midwestern Hybrids	44.9
Michigan Commercial Varieties	50.9
Check Duncan	53.8

Utilization of single crossed corn from inbred material commercially is a cumbersome procedure. In the second generation, such corn loses its first generation hybrid vigor and is much less productive than normal corn. To maintain yield, it is necessary to plant first generation seed each year.

It should be possible by the blending of a large number of inbreds into one synthetic strain to develop a corn which would maintain nearly its maximum yield from seed selected from the blend generation after generation. Accordingly, several synthetic lines which contained large numbers of both male and female inbred parents were produced. Some of these in their first year proved equal or slightly superior to Duncan corn in yield while

Table 4.—Comparison of the number of corn borers per 100 plants and yield in bushels of shelled corn per acre, 1932.

	Number Borers to 100 Plants	Yield Bushels to Acre
Maize Amargo Synthetic Lines	11.4	....
Synthetic Line No. 8B (Native Corn x Maize Amargo Inbreds)	11.2	29
Synthetic Line No. 24 (Native Corn x Maize Amargo Inbreds)	11.8	43
Synthetic Line No. 10 (Native Corn x Maize Amargo Inbreds)	14.4	38
Synthetic Line No. 22 (Native Corn x Maize Amargo Inbreds)	28.3	36
Synthetic Line (Native Corn x Native Corn Inbreds)	43.3	28
Check (Duncan Variety)	53.8	38

carrying a borer infestation no larger than that of pure Maize Amargo and only about one-fifth of that of Duncan, Table 4.

As may be expected, these synthetic lines differed in both yield and borer resistance. Synthetic line No. 24 gave the highest yield in the 1932 tests and was one of the strains most highly resistant to the borer. Synthetic line No. 8B was very resistant to borer attack but did not yield as well as Duncan corn, which was used throughout the field as a check on both yield and borer distribution. Synthetic line No. 10 yielded equally as well as Duncan corn and had only one-fourth as many borers.

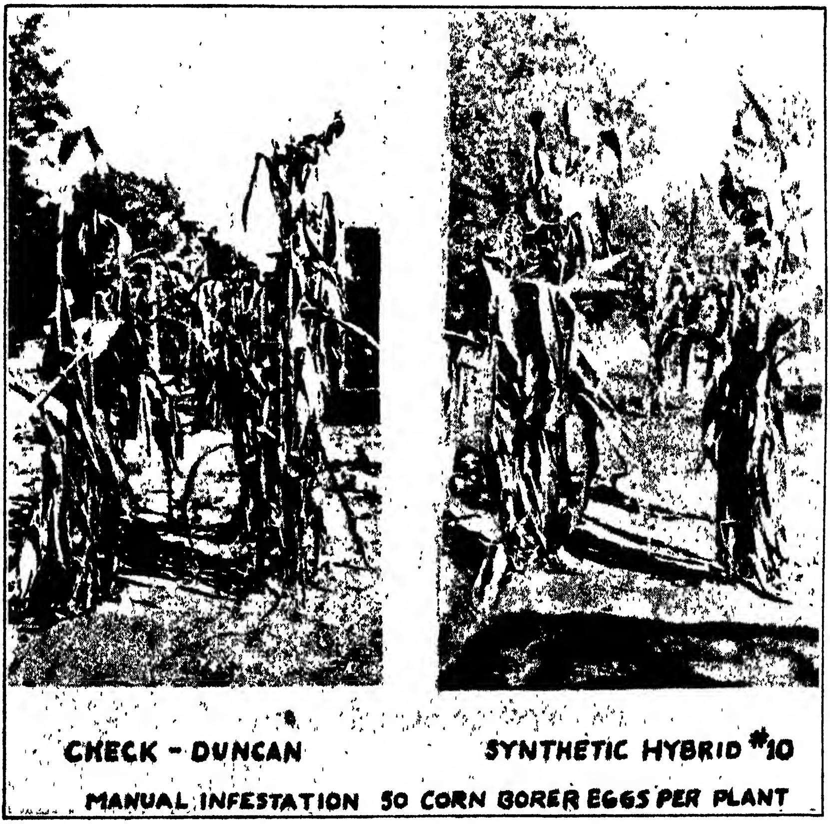

Fig. No. 1.

That resistance in these lines was not due to late maturity is shown by synthetic line No. 22, the latest maturing blend in the test. This line had twice as many borers as any of the other strains with Maize Amargo breeding.

The synthetic lines made up of native corn inbreds had almost as high a borer population as Duncan corn, but were considerably below Duncan, synthetic No. 24, and synthetic No. 10 in yield.

This fact has been established, that Maize Amargo has some characteristic which makes it resistant to borer attack. Further, this characteristic is transmissible to its progeny. From crosses between Maize Amargo and

native corn, strains may be selected which carry Maize Amargo's resistance to apparently as great a degree as does pure Maize Amargo. There is no evidence to warrant belief that such resistance is due to late maturity of the resistant lines since some of those most highly resistant were as early as Duncan while some of the susceptible lines were much later. That the resistance in selected Maize Amargo x native corn inbreds is not due to their lack of vigor is demonstrated by the susceptibility to attack of the native corn x native corn inbreds equally lacking in vigor, and by the continued resistance of selected blends of Maize Amargo x native corn inbreds, such blends having regained full vigor and productivity.

Figure No. 1 shows the ability of the borer resistant synthetic line No. 10 to stand up under heavy corn borer infestation while the check (Duncan) was destroyed by the borer. Approximately 50 eggs were placed on each plant in each plot by hand during the corn borer moth flight, and in the fall counts were made of the borers that survived. Even though so many eggs were placed on the plants the resistant synthetic line No. 10 at the end of the season had only 33 borers to 100 plants while Duncan had 160 borers to the same number of plants. Tests made on other borer resistant synthetics showed similar results.

The breeding of a superior variety of corn requires years of effort. Lines which in 1932 showed marked borer resistance and good yield are not yet perfected commercial corns. Further selection, perhaps back-crossing to the dent corns, will be necessary before satisfactory commercial corns resistant to the borer can be made available. However, should these lines continue to show definite resistance to the borer in future tests there is every reason to expect that such resistance can be one of the most potent weapons against the ravages of this insect.

Acknowledgments

All borer counts were made under the direction of C. B. Dibble, Section of Entomology, Michigan Agricultural Experiment Station.

LIME FOR SPRAYING PURPOSES

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Lime plays an important part in spray practice because it is used as a basic ingredient in the manufacture of lime-sulphur, calcium arsenate and bordeaux. It also is used in the preparation of homemade emulsions and alone or in combination with other materials to prevent arsenical injury, especially on peaches.

There seems to be much confusion in the minds of many fruit growers and others as to the compounds of lime or the grades of any one of these compounds that can be advisedly used in spraying practice. In order to provide information on this subject it is necessary to list and describe the various steps involved in the building up and deterioration of the several compounds of lime.

Lime compounds. Lime occurs in nature as *limestone* which consists essentially of *calcium carbonate.* Many limestones also contain magnesium carbonate. This will be discussed later but in order to simplify this classification at this point, only limestone that is mostly calcium carbonate will be considered. Limestone, when ground to a reasonably fine form, is used extensively for neutralizing acidity in the soil but is of no value in the preparation of spraying materials.

Limestone is quarried, broken up, placed in a kiln, and heated to a high temperature, which breaks down the calcium carbonate into calcium oxide and carbon dioxide. The carbon dioxide is a gas and is driven off, leaving the *calcium oxide* which is known as *quick lime.*

Quick lime (calcium oxide) is the form of lime, which for many years was used in all spraying work. Before it can be used, however, it must be slaked by the addition of water and the product is *slaked lime,* which is *calcium hydroxide* or *calcium hydrate* as the chemist calls it. This slaked lime (as prepared by the farmer) is always in the form of a paste but it is nothing but *hydrated lime* mixed with water. Ordinarily, slaked lime may not be thought of as being hydrated lime but such is the case, and it is the same chemical compound as commercial *hydrated lime.* The only difference is that in slaking quick lime an excess of water is added making a paste or putty while the manufacturer makes hydrated lime under controlled conditions and produces hydrated lime as a powder. It is commonly available in 50-pound paper bags and has almost entirely superseded quick lime in spraying practice.

Quick lime and hydrated lime, when exposed to the atmosphere, take up carbon dioxide and revert back to *calcium carbonate* and form what is usually called *air-slaked lime* or *carbonated lime.* The chemical composition of completely air-slaked or carbonated lime is the same as that of limestone but it is in the form of a powder instead of hard rock. Air-slaked or carbonated lime should not be used in spraying work.

Commercial Grades of Lime

It has been stated that limestone and air-slaked or carbonated lime, both of which are calcium carbonate, should not be used for spraying purposes. This leaves two forms, quick lime and hydrated lime, that may be used. There are several commercial grades of each.

Quick Lime. The best known form of quick lime is what is usually called *lump lime* or *stone lime* which comes, as the name indicates, in lumps from one or two inches up to six inches or more in size. Stone lime is a rather unfortunate term as it is easily confused with limestone. For many years quick lime was packed in wooden barrels and if not used very soon it became air-slaked, the barrel burst and the lime was of no value for spraying work. Lump lime is now commonly available in steel drums (regular barrel size of 180 pounds) with tightly-fitting covers that prevents air-slaking for a reasonable period so long as the covers are tight. Quick lime is also available as *pebble lime,* in which the lumps are small, about three-fourths or one inch in size, and rather uniform. Another form is *pulverized quick lime* which is quick lime ground to a fine powder. This has excellent properties in many ways. Pebble and pulverized quick limes, like lump lime, are now generally packed in tight steel drums.

Hydrated lime. There are several commercial grades of hydrated lime. *Agricultural hydrate* is a grade used for soil treatment and is usually rela-

tively coarse and contains considerable grit. It should not be used for spraying purposes. *Masons' hydrate* and *finishing hydrate* are used in making mortar and plaster and are nearly always unfit for use in spraying materials. *Chemical hydrate* and *spraying hydrated lime* are manufactured with greater care and are usually finer and more free from grit than the other grades. Agricultural, masons', and finishing limes almost always have entirely too much grit and are too coarse. It should not be assumed, however, that all chemical and spraying hydrates are equally fine and free from grit. Many of them have too much hard, sharp grit present which causes serious wear on pump and nozzle parts and possibly mechanical injury to fruit. No lime should be used for spraying until it has been determined that it is practically free from grit.

High-Calcium and Dolomitic Lime

In the foregoing discussion it has been assumed, in order to simplify the classification, that lime comes only from calcium carbonate. This is not always true. For the purposes of this discussion, limestones may be separated into two classes: (1) limestone that is composed almost entirely of calcium carbonate and (2) limestone that is a combination of calcium and magnesium carbonates and which is called dolomite. The magnesium carbonate in different deposits may vary from a small amount up to 40 per cent or more.

Lime made from stone composed mostly of calcium carbonate is called *high-calcium lime* and that made from stone that is a mixture of calcium and magnesium carbonates is called *dolomitic lime*. There are available, then, high-calcium quick limes and high-calcium hydrated limes, also dolomitic quick limes and dolomitic hydrated limes. All of these forms may become air-slaked or carbonated.

How to Choose a Spraying Lime

Limestone and air-slaked or carbonated lime have no place in spraying practice. The choice then, must be between quick lime and hydrated lime. Each of these is available in several physical grades of both the high-calcium and the dolomitic forms. Specific recommendations follow.

Home-made Lime-sulphur. Fruit growers who wish to make their own lime-sulphur solution should obtain a *high-calcium quick lime.* Dolomitic quick lime should not be used. Lump quick lime is the form generally used but there is no apparent reason why pebble or pulverized quick lime could not be employed with equal satisfaction. There might be some advantage in the use of the pulverized quick lime because of greater freedom from residue but this grade is probably less easily obtained.

Quick lime is also necessary in the preparation of self-boiled lime-sulphur and for this purpose the pulverized quick lime is undoubtedly best. However, self-boiled lime-sulphur is at present little used.

Bordeaux. Lime is necessary in the preparation of bordeaux which is used extensively in the spraying of grapes and potatoes. There is considerable difference of opinion as to the best form of lime for this purpose and until the matter is definitely settled, growers are advised to give first attention to the physical properties of the lime to make certain that it is practically grit free. Either quick lime or hydrated lime may be used for making bordeaux, but most Michigan growers have adopted hydrated lime because

of the greater convenience in handling. If quick lime is used, it should be a high-calcium lime but if the hydrate is used, it may be either a high-calcium or dolomitic product, but particular attention should be given to the amount of grit present. A high grade chemical hydrate or spraying hydrated lime is desirable and agricultural, masons' and finishing limes should be avoided.

Iron-Lime and Zinc-Lime. Lime is called for in the preparation of iron-lime and zinc-lime mixtures that are used with lead arsenate on peaches. High-calcium hydrated lime is recommended now for these preparations, and a chemical or spraying hydrate that has no grit should be selected. The value of dolomitic lime in these preparations has not been fully determined.

Other Uses. Dry-mix sulphur-lime and cold-mix sulphur-lime sprays should be prepared with high-calcium hydrated lime since they are likely to be combined with lead arsenate and zinc-lime or iron-lime. Only high grade chemical or spraying hydrates should be used.

In Conclusion. Many chemical and physical forms of quick and hydrated lime are available, several of which are not well adapted for use with spraying materials. High-calcium lime is indicated for certain uses; for other purposes, either high-calcium or dolomitic lime may be used but, in any instance, very close attention should be given to the physical properties of the lime to determine whether excessive amounts of grit are present. Best results with hydrated lime are possible from chemical or spraying hydrates. Agricultural, masons', and finishing limes should be avoided for spraying purposes.

SEDIMENT TEST NOT A RELIABLE GUIDE IN THE SELECTION OF MILK FOR HOMOGENIZATION

Analysis of Sediment in Homogenized Milk as Compared to That of Clarifier Slime

G. MALCOLM TROUT AND C. P. HALLORAN, SECTION OF DAIRY HUSBANDRY

The Michigan Station has called attention to the presence of a deposit which resembles sediment, appearing frequently in homogenized milk,[1] and also to the effective use of the clarifier in the elimination of this defect. Since the sediment test is used rather widely during certain seasons of the year to determine the quality of milk intended for market milk purposes, studies were made to determine if the sediment test would be a reliable guide in the selection of milk for homogenization, and also to determine the amount and composition of the sediment.

Three gallons of milk were obtained from each of 30 patrons delivering milk to the college creamery. Sediment tests were taken of each lot of milk. The sediment discs obtained were scored according to standard discs as shown in the United States Department of Agriculture Circular No. 384. The milk was filtered through regular weight filter cloths such as were

[1]Trout, G. Malcolm, and Halloran, C. P. "Sediment in Homogenized Milk." Mich. Agr. Exp. Sta. Quart. Bulletin, Vol. XV, No. 3, 1932.

used daily in the filtration of all milk which was bottled. Following the pasteurization exposure of 145° F. for 30 minutes, the milk was homogenized at the pasteurization temperature and at a pressure of 2,500 pounds per square inch. Three quart samples of each lot were secured, cooled to 40° F. and held at that temperature for 96 hours. The samples were examined at regular 24-hour intervals to note the presence, or absence, of sediment and its character. It is logical to assume that milk will seldom, if ever, be held in the home 48 to 96 hours before use. However, by holding the samples for that period it was thought maximum sedimentation would occur which would give an indication of the extent of the defect developed in the home under adverse conditions. The results of the 48-hour and 96-hour examinations are presented in Table 1. Inasmuch as the results secured from each of the three samples were identical in practically every case, they are tabulated as an average.

Table 1.—Relationship between the quality of milk as determined by the sediment test and the amount and nature of sediment present in the same milk when filtered, pasteurized and homogenized.

Patron Number	Score of sediment disc taken from milk before processing (a)	Amount of sediment when milk was held at 35-40°F. for (b)		Shade of color
		48 hours	96 hours	
51	8.5	+	++	Dark
24	8.0	++	++++	Dark
20	8.75	+	++	Dark
16	9.0	+++	++++	Dark
4	8.5	++	++++	Dark
11	8.5	+	+	Yellow
54	9.5	++++	++++	Dark
9	7.5	++	++++	Dark
62	9.0	+	++	Yellow
21	8.75	+	++	Dark
14	8.5	+++	++++	Dark
22	9.0	+	+	Yellow
23	9.5	++	+++	Dark
25	9.5	++	++++	Dark
26	8.5	+++	++++	Dark
17	(c)*	++	+++	Dark
36	"	+++	++++	Dark
8	"	++	+++	Dark
61	"	++	+++	Dark
10	"	−	++	Dark
27	"	++	+++	Dark
50	"	+	+	Yellow
15	"	+	+++	Dark
5	"	−	+	Yellow
13	"	+	++	Dark
6	"	+	++	Dark
12	"	−	++	Dark
7	"	+	+++	Dark
59	"	+	++	Yellow
2	"	++	+++	Dark

(a) Perfect Score for sediment is 10.

(b) Key:

No sediment	−	Pronounced	++
Slight	+	Heavy	+++
		Very Heavy	++++

(c) Score above 8.0, the specific score was not tabulated.

Although Table 1 does not include the results of the 24-hour period, it was found that, with few exceptions, the presence of sediment was apparent at this time.

The numerical scores given for the sediment in the unhomogenized milk, presented in Table 1 show the milk to have been of high quality in respect to sediment. A score ranging from 8.5 to 9.5 is generally considered to indicate very clean milk; from 7 to 8.25 fairly clean; from 5 to 7 fairly unclean, and from 0 to 5 very unclean. No sediment disc scored so low that the cleanliness of the milk as far as sediment was concerned was questionable. However, when the milk was homogenized and held at storage temperatures for a sufficiently long period, sediment deposited to the extent that 30 per cent of the samples were graded as having very heavy, 27 per cent heavy, 30 per cent pronounced, and 13 per cent slight sediment. There appeared to be no relationship between the quality of the sediment disc and the amount of sediment settling out of the homogenized product. In fact, the reverse may frequently be encountered, for example, one of the lots of milk yielded a sediment disc which merited a score of 9.5, but when homogenized, yielded a product in which the sediment formed was very heavy. From these limited trials, it would appear that the sediment test is of little value in the selection of milk for homogenization, insofar as its relation to the degree of sedimentation in the final product is concerned.

The question has arisen frequently concerning the weight of the sediment per quart and its composition. Since the deposit is so miscible and is present in such a thin layer, difficulty was encountered in obtaining a sufficient quantity from one bottle for analysis. However, by syphoning off the upper layers and combining the lower portion containing the sediment, the total deposits from 90 quarts were obtained, weighed, and then analyzed according to the Mojonnier method. A total of 28.9 grams were obtained from the 90 one-quart samples, or, approximately, one-third of a gram of sediment per quart. Although the deposits varied somewhat in intensity of color, two distinct types of color appeared, the grayish-black and the yellow. The dark precipitate appeared to contain foreign particles, detritus, while the light precipitate appeared creamy and cheesy as if it were high in fat and casein. Generally when the yellow color predominated the precipitate was small in quantity. The composition of the sediment is presented in Table 2.

Table 2.—The composition of sediment in homogenized milk as determined by the Mojonnier method.

Color of sediment	Water per cent	Fat per cent	Solids-not-fat per cent	Total Solids per cent
Dark gray to black.............. . . .	73 97	9.27	16 76	26 03
Yellow.........................	69.88	12 14	17 98	30.12

The composite sediment consisted of a slimy mass, resembling to a remarkable degree the appearance of clarifier slime. Clarifier slime, according to McInerny[2] has a chemical composition of 4.0 per cent fat, 71.33 per cent water, 28.67 per cent total solids, 3.15 per cent ash, and 2.15 per cent casein. Although the deposit from homogenized milk compared very favorably with clarifier slime in respect to the percentage of water and

[2]McInerny, T. J. "Classification of Milk," New York (Cornell) Agr. Exp. Sta. Bul. No. 389 (1917).

total solids, the percentage of fat was from two to three times higher than that in clarifier slime, while the solids-not-fat were considerably lower.

The sediment settling out of homogenized milk is so finely divided that a sediment test of the homogenized milk showing the defect gives little, if any, indication of the nature or extent of the defect.[1] From the results reported in this study, it appears equally true that a sediment test of the milk previous to homogenization is not always a reliable guide in the selection of milk for homogenization. The appearance of the composite sediment resembles clarifier slime, but differs somewhat in composition.

SEED FLAX VARIETY YIELDS IN MICHIGAN[1]

B. B. ROBINSON, SECTION OF FARM CROPS

During the past few years, there has been an increased interest in the growing of seed flax in Michigan, particularly in Chippewa county in the Upper Peninsula. There has also been some seed flax grown in the Lower Peninsula. This interest is partly the result of the low price of some other farm commodities and the higher income per acre from flax. The price outlook of flax seed should continue good in comparison to other grains because the United States has had no surplus problem with flax and continues to import about half of the seed consumed.

In 1928, due to this interest in growing seed flax in Michigan, experiments were started at the Michigan Agricultural Experiment Station at East Lansing, Michigan, to determine the seed flax yields which might be expected in Michigan. Mr. A. C. Dillman, Office of Cereal Crops and Diseases, United States Department of Agriculture, furnished seed of five varieties for planting in 1928. The results secured from tests grown in 1928, 1929, and 1931 are shown in Table 1. In 1928, each variety was tested in five separate trials and the results in the table are the average of the five trials. In 1929 and 1931 each variety of flax was tested in three separate trials and the results in the table are an average in each year of three trials.

Table 1 gives the seed yields in pounds per acre as well as bushels per acre. It shows the threshed straw yields in pounds per acre and the height in inches to which the flax grew in the field. The experiment was not conducted in 1930 but the results in the Table represent yields obtained in what might be considered one good year, a medium year, and a poor year for seed flax grown under the conditions at East Lansing, Michigan.

At present there is little or no sale for flax straw in Michigan, but should seed flax become a larger industry in the State there would probably exist a demand for good quality, long straw to be used in the manufacturing of upholstery tow. Under these conditions, a variety of flax having a taller growth and yielding a greater tonnage of threshed straw would be of more

[1]These investigations were conducted at the Michigan Experiment Station under a cooperative agreement with the U. S. D. A., Bureau of Plant Industry, Office of Fiber Investigations, and the Cereal Crops Division.

Table 1.—Yields obtained from seed flax varieties grown at East Lansing, Michigan, in 1928, 1929 and 1931.

No yields were obtained in 1930 as the test was not conducted that year. The flax was grown upon a Hillsdale soil and was planted at the rate of 40 pounds of seed per acre.

Variety	1928	1929	1931	Average	Bushels Per Acre
Seed Yield—Pounds Per Acre					
Redwing	1,006	767	429	734	13.1
Linota	922	652	477	684	12.2
N. D. 114	921	531	454	635	11.3
Bison	832	601	545	659	11.8
Winona	780	604	484	623	11.1
Threshed Straw Yields—Pounds Per Acre					
Redwing	3,312	1,419	1,234	1,988	
Linota	2,977	1,292	1,369	1,879	
N. D. 114	3,831	1,039	1,469	2,113	
Bison	2,804	1,189	1,362	1,785	
Winona	2,527	1,006	1,415	1,679	
Average Height of Plants in Inches					
Redwing	31.8	17.6	22.3	23.9	
Linota	34.0	18.3	23.3	25.2	
N. D. 114	33.4	18.3	24.0	25.2	
Bison	32.8	18.6	23.0	24.8	
Winona	31.4	17.3	22.6	23.8	

value than one with short straw and a low threshed straw yield, provided the seed yield was the same for both varieties.

All of these varieties are more or less resistant to wilt and Bison is resistant both to wilt and rust. It is not likely that farmers in Michigan will have a great amount of trouble with wilt until the acreage increases and farmers plant flax upon the same land more than once. However, rust is fairly prevalent in Michigan in some years when there is warm, damp weather which is favorable for the rust fungus to develop. In such cases as these, the earlier maturing varieties are desirable and in this respect Redwing is a week to 10 days earlier in time of maturing than the other varieties.

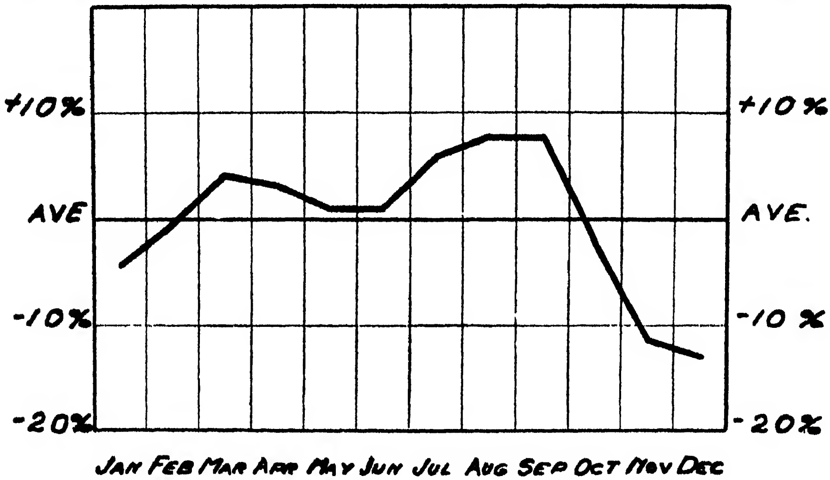
FEEDING SPRING PIGS ON PASTURE

V. A. FREEMAN, SECTION OF ANIMAL HUSBANDRY

Many tests have shown that spring pigs should be fed on pasture; and that, of many satisfactory crops, alfalfa, clover, and rape are among the best. Some of the methods upon which all feeders do not agree is whether the pigs should be full fed or limited in grain and to what extent it pays to purchase protein-rich supplements.

One of the first considerations with either of these questions is the time of marketing. Michigan spring pigs are marketed at slightly lighter weights and nearly two months earlier than the bulk from the corn belt. Grain costs more on our farms than on many corn belt farms and light hogs require less feed for each pound of gain than heavier hogs. Of even greater importance is the usual market decline during the fall months as shown by the following graph.

Seasonal change in prices of lightweight hogs (Chicago, 1922-1931 average)



This shows that higher prices may be expected on the average if the spring pigs are ready for market in August or September. The average drop from September to November during this ten-year period was from $10.67 to $8.72, and for the last three years, 1930-1932 inclusive, has been about $0.55 per month from August to December.

March and early April pigs can be finished at weights of 180 to 200 pounds for August and September markets if they are full fed and adequate supplements are used with good pasture. Decidedly more pasture and somewhat less grain could be used by these same pigs by limiting the grain fed throughout the summer months, but the saving in grain is more than offset by the usual decline in market value by the time the slower gaining pigs can be finished for market. The Michigan Experiment Station found that self-fed pigs required only 2.8 per cent more grain per hundredweight gain than a similar lot hand-fed three-fourths the grain consumed daily by the self-fed lot. The limited fed pigs were 18 days later in reaching the same market weight and sold for less margin above the feed cost of gains.

The feeding of protein supplements on rape pasture has been tested with corn, barley, and wheat at this Experiment Station during the last four years. Starting with 50-pound pigs each of these grains were fed alone, in combination with oats, also with tankage, and with both oats and tankage. Oats did not show any improvement with either barley or wheat but oats with corn did show some improvement over corn alone with pigs of this size. There was a decided advantage in adding tankage to each of these grains alone or in combination with oats as shown by Table No. 1.

Tankage with Grains on Pasture

	Corn or Corn and Oats	Corn and Tankage or Corn, Oats and Tankage	Barley or Barley and Oats	Barley and Tankage or Barley, Oats and Tankage	Wheat or Wheat and Oats	Wheat and Tankage or Wheat, Oats and Tankage
Total No. Pigs	64	86	88	62	43	44
Average No. days in period	120	102	108	99	124	105
Average Initial weight	55 1	55 0	53.5	53.5	51.9	50.3
Average Final weight	167.	182	180 6	182	180.1	177 7
Average daily gain	.93	1.24	1.17	1.30	1 03	1.22
Feed Consumed per Cwt. Gain						
Grain	394	320	400	362	428	350
Tankage	....	18	....	11	. . ....	13

These results show that the protein supplement is more necessary with either corn or wheat than with barley. As an average, with all of these grains, each 100 pounds of tankage saved 452 pounds of grain. With barley or with barley and oats, 100 pounds of tankage saved only 345 pounds of grain. Contrary to the expectation of many feeders, wheat alone or with oats was improved fully as much by the addition of tankage as was corn, based upon feed requirement per hundredweight of gain.

Tankage with corn alone made the most pronounced improvement in rate of gain. It had less effect when added to barley than when added to corn or wheat. The faster gains finished the pigs for an earlier market and increased the profit. Tankage shortened the feeding period nine days with barley, 19 days with wheat and 18 days with corn. The corn feeding period without tankage should have been about 33 days longer than with supplement as the average final weight of these pigs was 15 pounds less than the pigs fed corn and tankage.

These results indicate that early spring pigs should be fed liberally on grain and protein supplement. Other supplements that may be used are skim milk, buttermilk, Canada field peas, soy beans, and combinations of middlings, linseed oil meal, or soy bean oil meal with tankage.

Reasons may be advanced for limiting the grain for late spring and summer pigs that cannot be marketed before November or December. Among them are the maximum use of pasture, larger use of grain produced the same season without cost of carrying it over, and the production of feeder pigs to be used for hogging down corn and following steers in the feed lot. Limiting or withholding supplementary protein feeds has much the same effect.

WINTERING DRAFT COLTS

R. S. HUDSON, SECTION OF ANIMAL HUSBANDRY

In November, 1932, the Michigan State College Farm and Horse Department purchased 18 yearling and two-year-old draft colts for a feeding test to determine the comparative value of feeding shock corn in whole or chopped form.

The corn crop was a big one last season and many farmers had surplus of ears and stalks with no market for them. The College had a field of rather late maturing corn which had been planted for the silo but not used. It was cut before frost and shocked while still green. This made it ideal for feeding out of the bundle.

It was fed to the draft colts, a part in the bundle and a part after running it through a cutting-box to see whether there would be any advantage in going to the extra work of preparing it.

The colts came from the Thumb district of Michigan and from Kalamazoo and Jackson counties. They were rather uniform in type, low down, wide, and muscular.

For the first 45 days of the test, the colts in Lot I, the "Whole Corn Group," were allowed 26.44 pounds of shock corn per head per day, the equivalent of one and one-half shock per day for the Lot of nine colts, and 16.2 pounds of hay. Those in Lot II, the "Chopped Corn Group," were allowed 26.44 pounds of cut stalks and ears and 16.2 pounds of hay per

Lot I.—Showing manner of feeding.

day. This 26.44 pounds of corn fodder was made up approximately of 15.21 pounds of ear corn and 11.23 pounds of stover, by weight, per day. The colts in Lot I were fed the corn as it was scattered on the ground from a wagon after being loaded directly from the shock in the field. Those in Lot II were fed the corn in large troughs after it had been run through a silage cutter. Hay was fed in a large rack. All feeding was out in the open field and there were open sheds which the colts could get into for shelter.

During the 45-day period from November 15 to December 30, they were eating large quantities of hay and not caring for the cornstalks. The hay was reduced to four pounds for each colt per day and from the first of January to March 1 they were continued at this rate but were given all the corn they would eat. The winter was bad for feeding, especially out of doors, as there was lots of rain, wind, and soft weather. This sort of weather does not help in keeping the appetites keen and the feed clean and palatable. The colts wasted around one-third of the whole stalks and grain by tramping them into the mud. The colts in Lot II lost some of the cut fodder because the strong winds blew it out of the troughs.

Lot II.—Showing manner of feeding.

The first 45 days the colts in Lot I gained .63 pound per day and those in Lot II gained 1.83 pounds per day.

On January 1, the amount of hay was reduced to four pounds per colt per day, after which they did not do so well because of the inclement weather. The quantity of shock corn was reduced to 25.46 pounds per day as they did not seem to care for it.

Frequent weighing after January 1 showed a slight decrease in weights. Their appetites did not improve, apparently because of the soft weather and the decrease in the palatability of the corn which was becoming rather dry. From November 15 to March 1, the colts in Lot I showed a loss in weight of .336 pound per head per day, while those in Lot II lost an average of only .09 pound per head per day.

Thirteen hours were required to cut the shock corn for Lot I, taking the time of two men and a tractor.

Table 1.—Showing feed consumed, labor, and costs from November 15, 1932 to March 1, 1933.

	Lot I (Uncut)	Lot II (Cut)
Number of Colts	9.	9.
Days on Test	105.	105
Feed Consumed:		
*Shocks of Corn	141.	141.
Pounds of Hay	7,104.	7,104.
Pounds of Hay per Colt per Day	7.5	7.5
Cost of Feed Consumed:		
*141 Shocks of Corn @ $0.25	$35 25	$35 25
3.55 Tons Hay @ $6.00	21.30	21 30
Total Feed Costs	56.55	56.55
Feed Cost per Colt per Day	.059	.059
Cost of Labor:		
203 Hours of Hand Labor @ $0.30	$60.90	$60.90
13 Hours of 2 men and tractor @ $1.60 (cutting)	....	20 80
Total Labor Cost	60.90	81.70
Labor Cost per Colt per Day	.064	.086
Cost of Labor and Feed per Colt per Day	.123	.145

*Shock corn did not mature—Average weight of shocks ranged from 155 to 175 pounds, and husked 57 to 58 per cent corn which was too soft to crib. For this reason a price of $0.25 per shock was used for calculating the costs.

On March 1, the colts were brought to the barn where they were stalled, groomed, driven in harness, and each colt was fed individually in preparation for what might be termed spring work, but which in this particular case was for selling at auction on April 12.

The fitting ration might well be used by anyone who has a thin colt or horse which should be put in shape for work. This should be done by March 1, and no horse should be allowed to get thin during the winter if much work is to be expected from him in the spring.

Fitting Ration Fed Colts March 1 to April 9

Lot I

Whole corn and oats (⅔ ear corn and ⅓ oats by weight)

Oil meal (1 pound per colt per day)

Alfalfa (2nd cutting—morning and noon)

Mixed timothy hay at night

Lot II

Ground corn and oats in same proportion as Lot I

Oil meal same as Lot I

Hay same as Lot I

They were fed these rations until the 13th of March on the basis of one pound of grain and one pound of hay per day for every 100 pounds the colt weighed. On that date, they were increased to one and one-half pounds of grain per 100 pounds per day. Each colt was given one pound of oil meal per day in addition to the other grain. They were fed four pounds of second cutting alfalfa in the morning, four pounds at noon, and eight pounds of first cutting alfalfa and timothy at night.

To train them to harness each colt was driven daily with a mature well-trained horse. After two weeks they were driven in pairs on a wagon or in multi-hitches of four or five colts per team.

It was surprising how they gained in weight after March first. They of course were long-haired and thin but by sale day the long hair had disappeared and all were sleek and well-mannered.

For the fitting period from March 1 to April 12 the colts in Lot 1 made an average daily gain of 2.05 pounds per head on whole grain and those in Lot II gained 2.55 pounds daily per head on ground grain.

The colts in the feeding project were sold at auction on April 12. Table 3 which follows is a list of the animals, their description, and the prices they brought. These prices were good inasmuch as the colts were in thin condition; however, the auction shows the keen demand for horses at the present time and the disposition on the part of farmers to put money into young animals which they can use on the farm. The figures show that mares are preferred to geldings as the average price for the nine mares was $163.88 per head, and the average for the geldings was $142.22 per head. The average price per head for the entire lot was $153.05.

Table 2.—Showing feed consumed, labor, and costs from March 1, 1933 to April 9, 1933.

	Lot I (whole grain)	Lot II (crushed grain)
Number of Colts	9.	9.
Days on Test	40.	40.
Feed Consumed:		
*Pounds of Grain	5,175.9	5,054 4
Pounds of Hay	5,075.	5,450.
Pounds of Oil Meal	360.	360.
Average Pounds of Grain per Colt per Day	14 4	14.0
Average Pounds of Hay per Colt per Day	14.1	15.1
Cost of Feed Consumed:		
*Grain @ $0.60 per Cwt	$31.06	$30 33
Hay @ $6.00 per Ton	14.24	16 38
Oil Meal @ $1.70 per Cwt	6.12	6 12
Total Feed Costs	51.42	52.93
Feed Cost per Colt per Day	.142	.147
Cost of Labor:		
278 Hours of Hand Labor @ $0.30	$83 40	$83 40
Crushing Grain @ $0.10 per Cwt	....	5 05
Total Labor Cost	83 40	88 45
Labor Cost per Colt per Day	.231	.245
Cost of Labor and Feed per Colt per Day	.373	.392

*Grain consisted of 1/3 oats and 2/3 ear corn by weight.

This test indicates that shock corn, fed in the field during soft stormy weather will maintain the weight of horses, but, if gains in weight are desired, it should be accompanied with some grain and hay.

There is no great advantage in chopping or cutting shock corn for feeding to draft colts. Colts in Lot I lost .336 pound per head per day while those

Table 3.

No.	Color and Sex	Age	Weights on Nov. 15	Jan. 1	Mar. 1	Apr. 9	Selling Price
LOT I							
1-1	Brown gelding	Coming 3	1310	1315	1220	1316 6	$125.00
1-2	Sorrel filly	" 3	1393.3	1450	1373.3	1436.6	177 50
1-3	Red roan filly	" 2	1086.7	1115	1040	1173.3	125 00
1-4	Bay gelding	" 2	1083 3	1130	1060	1146 6	102.50
1-5	Sorrel gelding	" 2	1116.7	1155	1090	1176.6	177.50
1-6	Sorrel roan filly	" 2	1350	1370	1323.3	1360	192.50
1-7	Bay gelding	" 2	1083.3	1070	1020	1096.6	122 50
1-8	Blue roan filly	" 2	973.3	1010	956 7	1006.6	142 50
1-9	Brown filly	" 2	1166.7	1205	1160	1250	175.00
LOT II							
2-1	Brown filly	Coming 2	1166.7	1170	1116.7	1230	175.00
2-2	Sorrel gelding	" 3	1390	1415	1360	1436.6	177.50
2-3	Roan gelding	" 3	1276.7	1315	1243.3	1320	152.50
2-4	Bay gelding	" 2	940	980	960	1050	122.50
2-5	Sorrel mare	" 2	1043.3	1130	1056.7	1123.3	130.00
2-6	Sorrel gelding	" 2	1073 3	1165	1090	1203.3	177.50
2-7	Bay gelding	" 2	940	1000	950	1040	122.50
2-8	Blue roan filly	" 3	1190	1235	1193.3	1326.6	202.50
2-9	Brown filly	" 2	1253.3	1300	1223.3	1356.6	155.00

in Lot II lost only .09 pounds per head per day. With steady cold weather, with snow or continued frozen ground colts would probably show some gain on shock corn, especially if the corn was sound and mature and fed in more liberal quantities.

Ground grain produced greater gains when fitting colts for spring work or for sale than whole grain.

DURABLE FINISHES FOR ANY KIND OF FLOOR

C. H. JEFFERSON, SECTION OF AGRICULTURAL ENGINEERING

Keeping the floors clean and attractive is a problem in nearly every home. It is particularly important in the farm home where the floors, which are often of soft wood or linoleum, receive heavy wear.

The usual treatment for soft wood floors is a coat of paint that must be renewed frequently. This type of finish has much in its favor when used on floors that do not receive constant and heavy traffic. It is economical, easy to apply, and requires no special treatment. Over soft wood floors in bedrooms or rooms partially protected by rugs, a paint finish is satisfactory. A coat of wax over the paint will preserve the finish and make the surface easier to keep clean.

A paint finish has not been satisfactory on floors that are subject to much wear and frequent scrubbings such as kitchen, dining room and hall floors. The paint forms a thin film on the surface that is easily scratched and under continual traffic will check and flake off leaving the bare wood exposed. A varnish finish will do exactly the same thing, but gives a little better wearing surface than paint. As soon as the membrane finish is destroyed, the floor absorbs moisture; and dirt and grease are ground into the pores. Scrubbing with soap and water which is necessary to loosen this embedded dirt also removes some of the paint or varnish and further exposes the wood. Warped floors with wide unsightly cracks are often caused by the accumulation of moisture as a result of scrubbing.

Perhaps more linoleum floors have been scrubbed out than were actually worn out. Linoleum is composed of ground cork fiber mixed with linseed oil and baked on a burlap back. Each time the floor is washed some of the oil is removed until finally the fiber is exposed. Without the oil which acts as a binder to hold the fibers together, they soon get brittle and crumble away. A linoleum floor should never be scrubbed with a strong soap and hot water. One of the best finishes so far developed for linoleum is a penetrating or sealing finish, which will be discussed later.

It is, no doubt, necessary occasionally to wash any floor but scrubbing with strong soap and water should be avoided. New finishes have now been developed which help make it possible to maintain floors without scrubbing. Before discussing these new materials, the purpose of a good floor finish should be given.

A good floor finish should be serviceable as well as attractive. It should provide a wearing surface that is not easily marred, that will not check or flake off, and that is economical to maintain without scrubbing. In doing

so, it should also seal the surface of the floor against penetration of moisture, dirt, or stains. The new finishes recently developed meet these requirements much better than the ordinary type of finish. Experiments extending over a period of nearly two years have disclosed many of their better qualities.

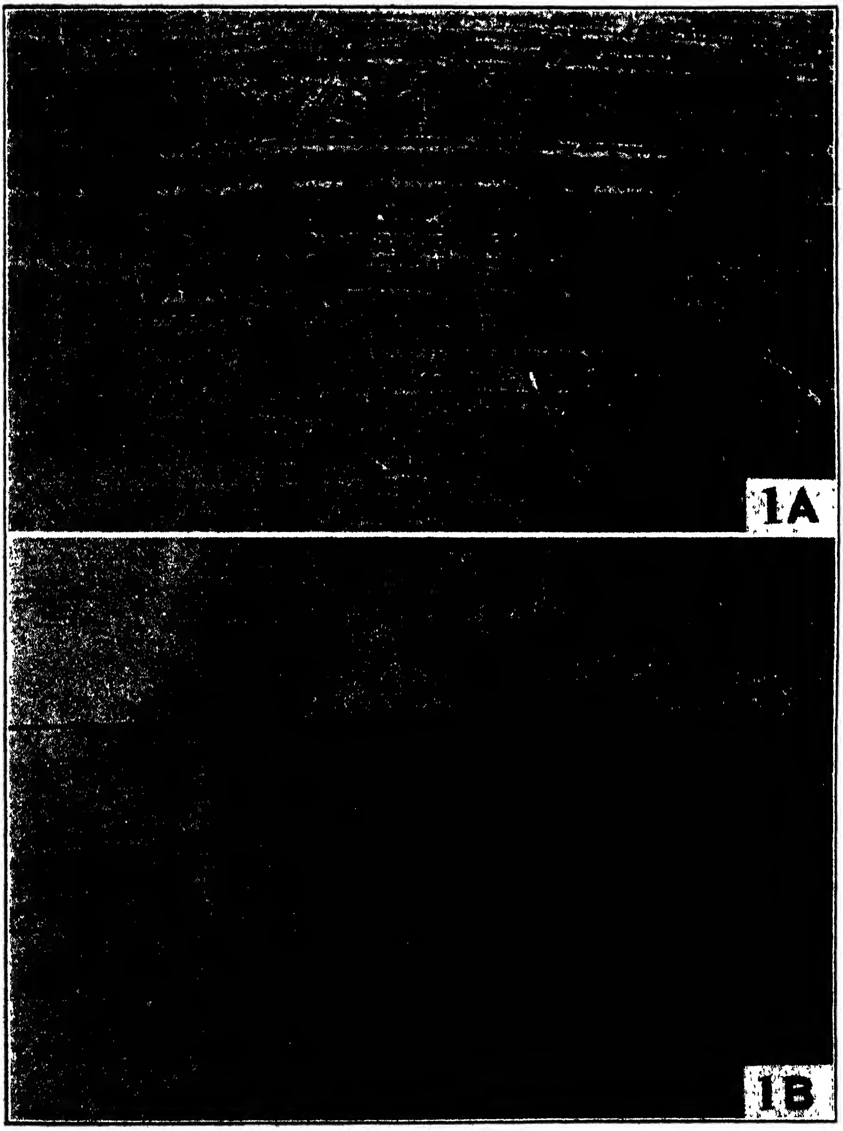


Fig. 1A.—A section of maple floor panel finished with a light oak stain, two coats of spar varnish and two coats of paste wax. Note the scratches where the varnish has been destroyed exposing the bare wood.

Fig. 1B.—A section of maple floor panel finished with a light oak stain and two coats of penetrating finish. The surface is practically free from marks of any kind. In no place is the bare wood exposed.

The new finishes are classified as penetrating or sealing finishes. They differ from the ordinary floor finishes in that they penetrate and actually become a part of the floor rather than a surface film that is easily destroyed. Since the material penetrates deeply into the floor before it hardens, the floor is effectively water-proofed and preserved. A very thin film is left on the surface which may be polished, but it will not scratch or chip off as so often happens with paint or varnish. Since the finish is practically even with the floor surface and remains intact, there are no tiny crevices where dirt may lodge. Scrubbing therefore is no longer necessary. If grease or

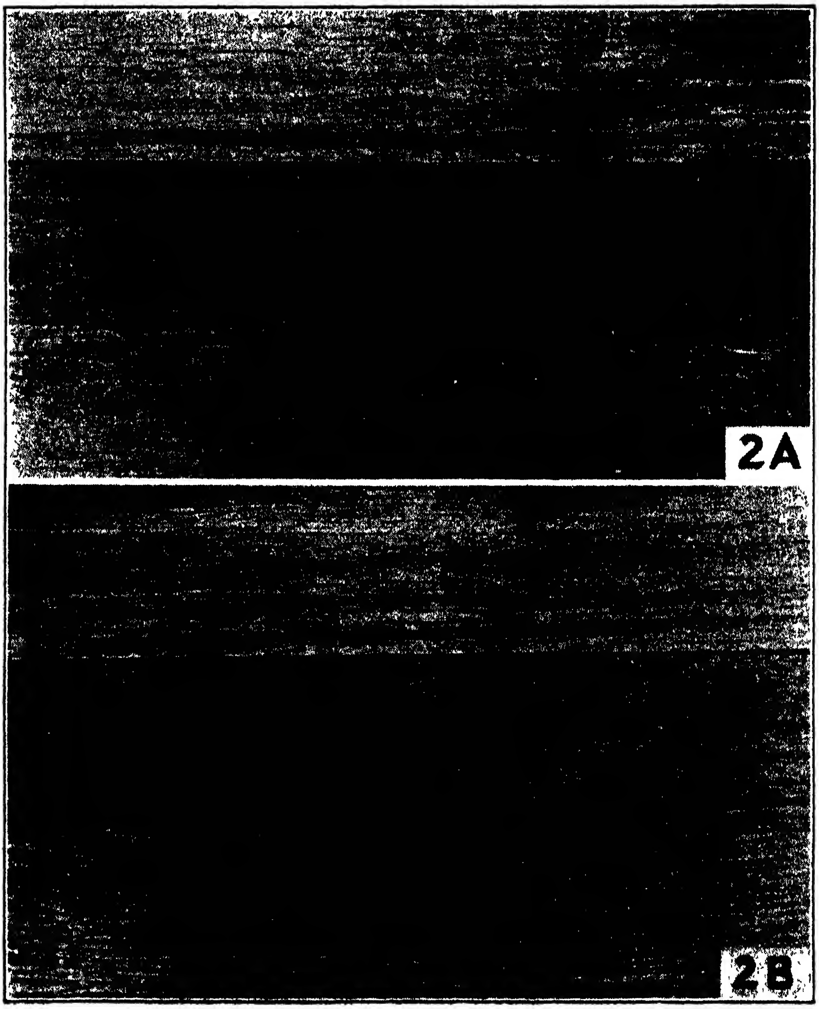


Fig. 2A.—A section of oak floor finished the same as in Fig. 1A. The finish is broken in many places. The top board was later refinished.

Fig. 2B.—A section of oak floor finished the same as in Fig. 1B. The finish is relatively smooth and unbroken. The top board was later refinished.

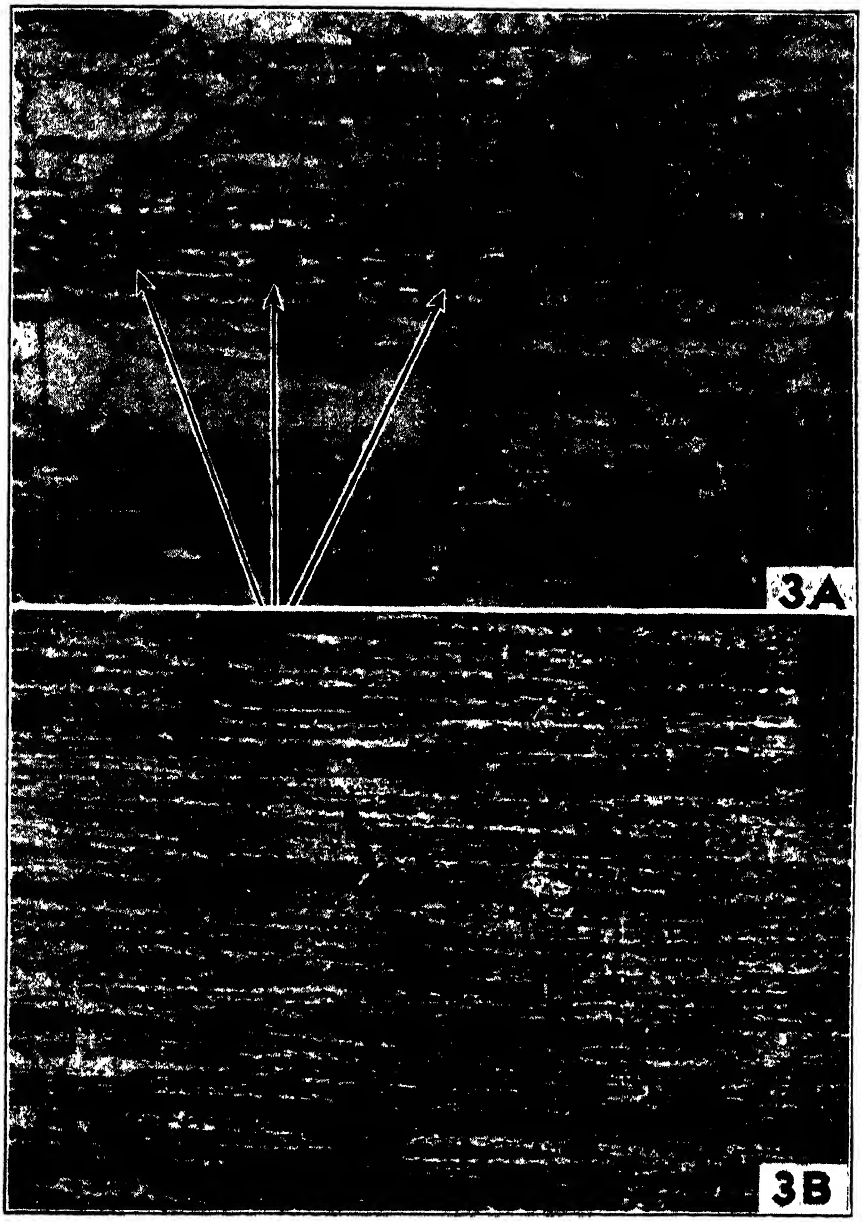


Fig. 3A.—A micro-photograph (about 10 diameters) of a small section of the top board in Fig. 2A showing the varnish finish. Some of the dark areas are grain in the wood, but it is easy to distinguish the bare wood. Note several areas indicated by arrows where the varnish has been chipped off.

Fig. 3B.—A micro-photograph (about 10 diameters) of a small section of the top board in Fig. 2B, showing the penetrating finish. There are no areas where the finish is chipped off and no scratches to expose the wood.

other materials that would stain an ordinary floor are spilled, they can be wiped up with a damp cloth without leaving a spot.

If the floor does become spotted or soiled with tracked-in dirt and can not be cleaned with a broom or dust mop, then it may be necessary to use a little clear water. It is good practice to wipe up all excess water as soon as possible after washing the floor, although water, if left to evaporate on this finish, will not leave a spot as it would on varnish. If a soap is used, it should be a mild one or one with a linseed oil base. The linseed oil soap, which may be obtained at most paint stores, leaves a residue of oil and gradually builds up a wearing surface.

The maintenance of floors finished with a penetrating material is also a simple matter. Worn places around tables, sinks, or in doorways may be renewed by pouring a small quantity of the material on the worn area and rubbing it in with fine steel wool. Any dirt that is loosened should be wiped up immediately with a clean dry cloth. The new application blends perfectly with the original finish and leaves no traffic lanes so common to paint or varnish finishes. The entire floor may also be refinished in the same way, thereby eliminating expensive scraping or sanding.

The penetrating finishes may be used on either hard or soft wood or on linoleum. The surface to be finished is prepared the same as for varnish or wax and the material applied according to manufacturers' directions. In general, the first coat is brushed or mopped on liberally and allowed to penetrate. At the end of 12 to 24 hours, depending upon drying conditions, the surface is buffed lightly with fine steel wool and a second coat is applied. Before the second coat dries, usually in 10 to 20 minutes, all material remaining on the surface should be wiped up with a dry cloth. Allow the second coat to dry 12 hours before the third coat is applied. A third coat is advisable on floors that receive heavy traffic, but in some cases a wax may be substituted.

There is also a great difference in the types of waxes now available. Nearly every one is familiar with the paste and liquid waxes that must be thoroughly buffed to obtain a hard and polished surface. These waxes are hard to apply, must be renewed often and are usually quite slippery. The new "water solvent" or "no-buff" waxes are preferable in many ways. They are applied with a cloth dampened with the wax in the same way that furniture polish is applied. A very thin uniform coat is spread on the floor and allowed to dry. It dries quickly with a luster and requires no polishing. A number of thin coats well distributed are much better than one thick coat. The water solvent waxes of which there are a number on the market are much easier to apply, harder and more durable than the paste waxes.

The accompanying photographs show sections of the floor where these finishes were tested and indicate the relative durability of each finish.

The conclusions drawn from a study of these test floor panels up to the present time are:

1. The finishes that remained on the surface did not stand up under heavy traffic.
2. The finishes which penetrated the wood instead of remaining on the surface showed greater durability.
3. The penetrating finishes are quickly and easily renewed.
4. Badly worn varnish finishes must be removed before a new finish is applied if a smooth uniform surface is to be obtained.
5. Penetrating finishes are not satisfactory over varnish or wax.

6. Though no test panel of linoleum was provided, the penetrating finishes have been observed on linoleum floors where the work of maintenance is considerably reduced by its use.
7. The "water solvent" or "no-buff" waxes were more easily applied, more durable, and less slippery than the ordinary paste waxes.
8. The "no-buff" waxes seemed to be more durable over the penetrating finishes than over varnish. This may be because the varnish gave away before the wax was entirely worn off.
9. The penetrating finish without a coat of wax is more desirable on kitchen floors.
10. A thin coat of wax is more durable than a thick coat.

TRACTOR FUELS

E. C. SAUVE, SECTION OF AGRICULTURAL ENGINEERING

Tractor fuels may be classified as gasoline, kerosene, fuel oil, crude oil, alcohol, and alcohol-gasoline blends. Petroleum fuels are known as hydrocarbon fuels because they are composed principally of hydrogen and carbon in certain definite ratios. These elements produce heat when burned in the presence of oxygen.

Gasoline, Kerosene, and Distillate Fuels

Fuels are obtained from crude oil by a process of distillation and subsequent refinements. Briefly, the process is as follows: when heat is applied to the crude petroleum, the light vapors with low boiling points escape and later are condensed back into liquid form. Within certain low temperature ranges, all vapors which are distilled off are classified as gasoline. Within a given range of increased temperatures, additional vapors are distilled off which are classified as kerosene; and, likewise, an additional range of temperature increase produces what may be called fuel oil or distillate.

The gasoline produced as described above is known as "straight run" gasoline. Formerly gasoline was rated according to its Baumé gravity. This was an index to its value as a fuel. For example, a 70° Baumé fuel was considered superior to 58° Baumé fuel because of its greater volatility.

However, as it became necessary to increase the production of gasoline from a given amount of crude oil, additional fractions were extracted from the heavier distillates by what is known as the "cracking process." These fractions were blended with the gasoline as obtained in regular distillation. Thus the gravity test of a gasoline as formerly used is no longer an index of its value as a fuel.

Fuel Value by Distillation

The value of a fuel is now determined by heating the liquid to ascertain the temperatures at which certain definite percentages of the total amount is boiled over and condensed.

Table 1.—Distillation data for gasoline.

	Temperatures for each 10% distilled off										
	Initial B. P.	10%	20%	30%	40%	50%	60%	70%	80%	90%	Max. B. P.
Gasoline No. 1	97	127	143	155	165	176	187	193	206	225	300
Gasoline No. 2	96	162	210	247	272	295	313	335	356	381	425

The distillation test of the two grades of gasoline, as shown in Table 1, is significant as regards their values as engine fuels. In explanation of this test, heat is applied to 100 cubic centimeters of gasoline. The temperature at which the first drop is passed over is known as the initial boiling point. This is 97° F. for Gasoline No. 1. When 10 per cent is distilled over, the temperature has risen to 127° F. and so on for each succeeding 10 per cent distilled over. The initial boiling points of the two gasolines are 97° and 96° respectively, showing very little difference. However, at 300° F. all of the 100 cubic centimeters is distilled over for the Gasoline No. 1 while it requires a temperature of 425° F. to distill all of Gasoline No. 2. It is, therefore, possible to draw the following conclusions:

Gasoline No. 1

1. Would be classified as a high test gasoline.
2. Low initial boiling point contributes to easy starting of engine.
3. Would cause quick pick up of speed when burned in an engine.
4. Would contain less heat units per gallon than a denser or less volatile fuel.

Gasoline No. 2

1. Would be classified as a common grade of gasoline.
2. Low initial boiling points also contribute to easy starting.
3. The higher boiling points required for distillation of successive increments of 10 per cent would indicate a slower combustion rate when used in a motor.
4. Would contain more heat units per gallon than a lighter or more volatile fuel.

Therefore, a distillation test of fuels is highly important in determining the value of a fuel for a particular purpose. This is particularly true of blended gasolines such as are on the market today.

The boiling point range of a composite sample of gasoline would probably be from 96° F. to 425° F. and for kerosene from 346° F. to 538° F. For fuel oil commonly known as distillate, the boiling point would be in excess of 527° F.

Value of a Fuel in an Engine

The value of a fuel for internal combustion engine use will depend on the following:

1. The number of heat units (B. T. U.*) in the fuel.
2. The distillation characteristics of the fuel as previously mentioned.
3. The completeness with which combustion takes place in the engine.
4. The compression pressure for which the engine is designed.
5. The thermal efficiency of the engine which is dependent upon the design of the engine.

Heating Value of the Common Fuels

The most common fuels used in tractors are: gasoline, kerosene and fuel oil. The heating values of these fuels, even of the same kind, vary considerably, but in general it may be stated that a pound of each of the above fuels contains about 19,000 B. T. U. Thus a gallon of a heavy fuel such as fuel oil contains more B. T. U. than a gallon of a lighter fuel such as gasoline because of the difference in weight.

If it can be assumed that the heating value of a fuel is the sole measure of its effectiveness in a tractor, then we must rate fuel oil, kerosene and gasoline in the order of value on a per gallon basis. But other factors must be considered as previously mentioned. The performance of these fuels in an engine or tractors tells the true story.

Table 2.—Performance of tractors with common fuels.

	Gasoline	Kerosene	Distillate
Number of 2 cylinder tractors	0	2	3
Number of 4 cylinder tractors	22	17	5
Number of 6 cylinder tractors	6	0	0
Total number of tractors ..	28	19	8
Fuel in pounds per h p hr at rated load on belt	735	702	727
Average weight of fuel in pounds per gallon	6 11	6 78	6 90
Approximate B. T. U. per gallon*.....	120,673	128,820	129,375

*The data in Table II were summarized from the Nebraska Tractor Tests as found in the Tractor Field Book published by the Farm Implement News Company, Chicago, Illinois.

Analyzing the item in Table 2, entitled "Fuel in pounds per h. p. hr. at rated load on belt," it will be noted that the greatest economy occurred when tractors were burning kerosene for fuel. Thus, it is not always correct to say that the fuel which has the greatest B. T. U. value per gallon will result in the greatest efficiency when used in an internal combustion engine.

Table 2 does indicate, however, a relatively low heating value of distillate

*B. T. U. = British Thermal Unit which is defined as the amount of heat necessary to raise the temperature of one pound of water one degree Fahrenheit.

as compared with kerosene. This figure was based on a weight per gallon of 6.9 pounds as averaged from the Nebraska Tractor Test data. Distillates have been known to weigh as much as a pound per gallon more than this value, which would account for a considerable increase in heat units.

Crude Oil as a Tractor Fuel

The discovery of petroleum in Michigan and a rather general use of tractors caused a desire to use a cheap fuel for the production of power. Crude oil could be obtained at a very small cost in some localities and was used in some tractors in the area surrounding the Mt. Pleasant oil fields. An investigation of tractors using crude oil in whole or in part revealed the following information:

1. More crude oil is consumed per day than would have been the case with the use of the lighter fuels such as gasoline and kerosene.
2. The extra consumption of fuel was, no doubt, due to the fact that the unburned crude oil would pass by the pistons and accumulate in the crank case. A common practice was to drain partially the crank case twice a day. From one to two gallons were removed daily. No new lubrication oil was added between changes.
3. At the time of an oil change, it was necessary to heat the oil to permit easy draining. An examination of this oil found it to be much heavier than the lubrication oils recommended for use.
4. A sludge would form in the crank case of the tractor which was difficult to remove.
5. The tractor motor functioned very poorly at idling loads where the straight crude was used. Likewise, for equal mixtures of crude oil and gasoline, the motor did not idle satisfactorily.
6. Fouling of spark plugs was of frequent occurrence.
7. Motor power was somewhat diminished as a result of the use of crude.

Alcohol and Gasoline Blends

There has been considerable interest manifested in the possibility of using alcohol and gasoline blends for automotive applications. Several universities and colleges have been conducting tests with this fuel, but at the present time, there is a lack of definite information. The Agricultural Engineering Section of this Station recently conducted some tests, using a stationary farm engine with 10 and 20 per cent blends of alcohol and gasoline. The engine under test was designed for kerosene use; that is, the compression pressure was low as compared with that of similar engines designed especially for gasoline or alcohol use. In general, the tests revealed that there was but slight difference in general engine performance between gasoline alone or with 10 and 20 per cent of alcohol-gasoline admixtures.

Engine speed regulation was somewhat better for gasoline. When shifting from gasoline fuel to the alcohol blends, the engine speed would drop for the same load applied to the engine. This was particularly true at heavy loads. It was necessary to open the fuel needle valve or increase the consumption slightly to give similar results as compared with gasoline fuel. The maximum power developed was approximately the same for gasoline as for the alcohol-gasoline blends.

Economics of Motor Fuels

In the final analysis, the comparative values of fuels for internal combustion engines will depend upon their cost for each horsepower per hour of energy produced. This statement is based upon the assumption that the fuels will be used in motors designed for their most efficient use and that there is equal depreciation of the engine for each type of fuel.

Table 3.—Costs of fuels per horsepower per hour.

Fuel	Cost of Fuel per Gallon Local Quotation Cents	Cost per h.p. per hour Cents
Distillate	6 9	0 727
Kerosene	8 1	0.838
Gasoline (common)	12 6	1.516
10% Alcohol—90% Gasoline	14 34	1 664
20% Alcohol—80% Gasoline	16 08	1.812

The cost of fuel necessary to operate a 20-horsepower tractor to capacity for a period of 10 hours would be as follows: for distillate $1.45; kerosene $1.68; gasoline $3.03; a 10 per cent alcohol-gasoline blend $3.32; and a 20 per cent alcohol-gasoline blend $3.62.

The cost of alcohol-gasoline blends is based on alcohol at $0.30 per gallon and gasoline at the prevailing price of $0.126 per gallon to the farmer. The values in the "cost per h. p. hour column" for distillate, kerosene and gasoline are based on average consumption of fuel taken from the Nebraska Tractor Test data.

Conclusions

In order to evaluate properly any fuel for use in internal combustion engines, the following factors must be considered:

1. Gasoline is the most volatile of the petroleum fuels. It affects easy starting of engines and contains the greatest number of heat units per pound as compared with other fuels. Being more volatile than kerosene or distillate, there will be less dilution of the crank case oil, contributing to more efficient lubrication and longer life of engine parts.
2. The value of a gasoline is no longer dependent upon the gravity of the liquid, but upon the nature of its distillation; that is, a gasoline that completely vaporizes at low temperatures may be termed a high test gasoline while one that completely vaporizes on high temperatures may be termed a low test gasoline.
3. That, in general, more power will be produced in an engine using a low test gasoline than for a high test gasoline.
4. The power or efficiency of an engine is not necessarily in direct ratio to the B. T. U. of the fuel used.
5. Maximum power will depend mainly upon a proper application of

engine compression pressure, a correct ratio of fuel and air for complete combustion, and the heat value of the fuel.

6. That kerosene and distillate are satisfactory fuels for tractor use when such tractors are designed to accommodate these fuels. Tractor designers seem to favor gasoline for fuel, especially in the small power, high speed units.

7. Although crude oil has been used in some localities for tractor fuel, investigation seems to indicate that it is questionable economy.

8. That although alcohol and gasoline admixtures are not now used in tractors there is evidence of satisfactory performance being obtained with 10 per cent blends of alcohol with gasoline. According to estimates, the added cost of 10 per cent alcohol-gasoline blended fuels will vary from two to three cents a gallon.

9. The most economical fuel for tractor use based on performance and cost is distillate, followed in order by kerosene, gasoline, and alcohol-gasoline blends.

RATE OF PLANTING CORN FOR GRAIN

J. R. DUNCAN, SECTION OF FARM CROPS

The proper rate of planting corn to get maximum grain yield is influenced by a number of factors including per cent germination, variety of corn, soil type and fertility, and weather condition during the growing season.

The trials described, herewith, were conducted to determine the influence on yield and quality of different planting rates when early, medium and late maturing varieties of corn were used.

The method of planting was to space the hills three feet, six inches apart each way and vary the number of kernels per hill. Four varieties of corn were used each year. In the four years, the test was on four soil types, two in a medium good state of fertility and two in a low state of fertility. Sufficient rainfall for maximum growth was lacking in three of the four years. In all cases, the seed was of good germination.

The varieties of corn used were Duncan Yellow Dent from southern Michigan, Golden Glow from the south central section and a Golden Glow from northern Michigan. M.A.C. Yellow Dent, a variety well suited to this locality, was used as the check throughout all series. The "early" Golden Glow from Charlevoix was only about three days earlier than the "medium" Golden Glow, this partially accounting for the similarity in the yield results of these two varieties.

The yield of the corn in this project was below the state average in 1928-29-30 and above the average in 1931. The state average for the four years was 26.6 bushels per acre.

The fact that during three of the four years this test was conducted the droughty weather condition during portions of July, August, and September very materially reduced the yield of the "late" variety and to some extent the "medium" variety and did the least damage to the "early" variety. This was indicated by the stage of growth of the plants at the time firing of the stalks occurred and the extent of damage due to this.

Summary Four Years Results, 1928-1931.

1928–1931. Yield: Per cent of Check

Kernels per hill	2	3	4	5	6
Check M. A. C. yellow dent		100			
Late Corn	93	122	95	81 6	
Medium Corn		103	101	94 7	70
Early Corn		100 4	104	84.	80

Market Quality, Per cent

Kernels per hill	2	3	4	5	6
Check M. A. C. yellow dent		76			
Late Corn	81	73	67	56	
Medium Corn		70	74	57	54
Early Corn		72	68	66	58

Damage due to firing started earlier in the heavy planting rates than in the normal or thin planting rates of all varieties.

This would seem to account for the closeness of the yield results. Nevertheless, the trend of the results for the various planting rates indicates that when corn is planted for grain purposes the planting of the "late" variety or one that uses the maximum growing season in this locality and on soil somewhat low in fertility gives maximum yield when planted at the rate of three kernels per hill. The "medium" and the "early" gave as great a yield when planted four kernels per hill as at three kernels per hill and progressively reduced yields were obtained at five and at six kernels planting rates.

Market Quality

The per cent of marketable ears was highest where the "late" corn was planted only two pernels per hill and became lower as each succeeding planting rate was increased.

The per cent market quality of the "medium" and the "early" varieties remained about the same for the three and four kernel planting rates and then decreased in each of the thicker planting rates.

Conclusion

If corn is planted in hills 3½ x 3½ feet apart under combinations of soil and weather conditions similar to those encountered in this experiment, the following conclusions appear warranted:

1. Large growing corn varieties requiring the full season to mature will give their maximum yield of good quality grain if planted at the rate of three kernels per hill.
2. Earlier maturing varieties with smaller stalks and requiring less than the available growing season to ripen will produce maximum yields of good quality grain, if planted either three or four kernels per hill and decrease in both yield and quality with heavier planting rates.
3. Per cent marketable ears in the "late" variety is greatest in the thin planting, gradually decreasing as thickness of planting is increased.

In the "medium" and "early" varieties there is no decrease in per cent marketable ears until after four kernels per hill planting rate is passed.

EARLY BLIGHT THREATENS MICHIGAN 1933 CELERY CROP

RAY NELSON AND L. C. COCHRAN, BOTANICAL SECTION

Leaf blight caused by *Cercospora apii* caused very serious damage to the Michigan celery crop of 1932. In the intensive districts of Kalamazoo, Muskegon, and other sections where both summer and fall crops are produced, this disease was unusually destructive. The outbreak of early blight in 1932 was the most serious epidemic of which we have record. In previous years the disease has usually been of slight importance and has seldom caused damage except in occasional fields.

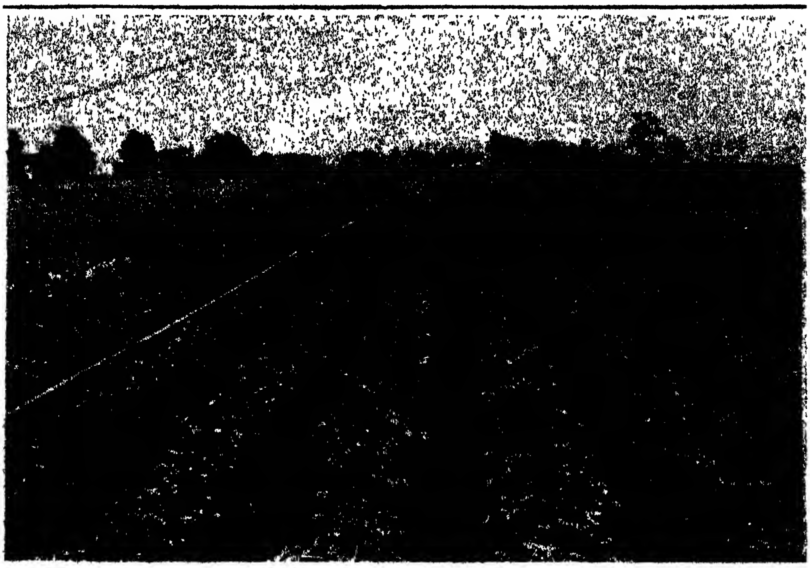


Fig. 1.—A field of celery at Kalamazoo, August, 1932, ruined by the early blight disease.

Normal climatic conditions in Michigan are unfavorable for destructive epidemics of early blight and it is only in years when suitable seasonal conditions prevail that the disease assumes epidemic proportions. The seasons of 1930 to 1932 were characterized by high summer temperatures. In addition heavy fogs and dews were common on the celery marshes. These conditions were very favorable for the development of early blight. The disease was noted in many fields in 1930, it increased greatly in 1931 and in 1932 was the most important celery disease in Michigan. Heavy losses were caused in the Kalamazoo district and fields of summer celery were ruined in many other sections.

The early blight fungus overwinters in the old trash from the previous years' crop and again becomes active with the onset of warm weather. Since the amount of diseased material has greatly increased during the past three seasons the fungus is now thoroughly intrenched in most celery districts and growers should take cognizance of the possibility of a more serious outbreak in 1933. No one can foretell what the seasonal conditions will be this year but if temperatures are at all favorable early blight will certainly be a serious disease in the Michigan celery crop.

Early Blight Not the Same Disease as Late Blight

In normal seasons, the most common leaf disease of Michigan celery is late blight caused by *Septoria apii graveolentis*. This disease is known to most growers as "black" blight due to the occurrence of numerous, black pimples in the centers of the small, brown, greasy spots on the leaves and petioles. The disease is readily identified by these black pimples which are

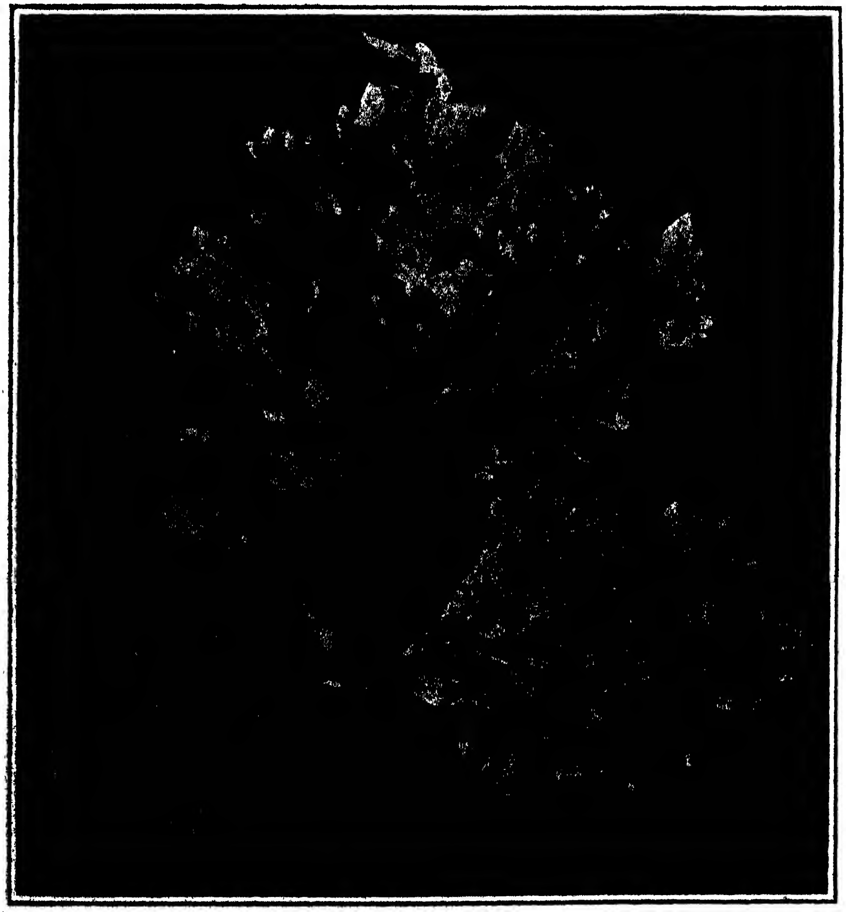


Fig. 2.—Portion of a celery leaf badly affected with early blight. The spots are light brown to dark gray with ashen-gray centers.

usually present in the blight lesion. Late blight occurs generally in the late crop but is also of great importance in summer celery produced in the intensive districts where irrigation is used.

Early blight is destructive only in summer celery and requires high temperatures for its rapid development. The disease attacks both leaflets and petioles forming comparatively large, brown to dark gray spots with an ashen gray center, Fig. 2. Where only a small number of spots occur on a leaflet the individual lesions are larger and usually split lengthwise, Fig. 3.

Fig. 3.—Early blight lesions on celery leaflet showing the papery texture of the diseased areas and the production of felty masses of spores.

When the leaves are dry, the central portion of the early blight spot is covered with a felty mass of spores of the causal fungus. These spores are produced in enormous numbers, are very light, are easily broken off from the fungous threads that bear them, and are widely distributed by even slight currents of air. The gray color of the spots, the absence of black pimples, and the presence of the felty mass of spores readily identify the early blight lesions on the leaflets. On the petioles elongated brown spots occur, often involving large areas and causing the entire leaf to shrivel and die. Fields badly affected with early blight appear as though scorched by fire, Fig. 1.

Seasonal Conditions Determine Occurrence of Leaf Blights

In cool, wet seasons late blight is always a destructive disease and because such conditions usually prevail in the fall the late crop of celery is most seriously affected with this disease. The hot, dry weather of July and August does not favor the rapid development of late blight. However, when the night temperatures are normal and irrigation is used in late afternoon or evening, late blight may be very destructive in the summer crop. Splashing water is necessary for the distribution of the late blight spores which are not disseminated by winds but only by drops of water splashed from diseased leaves. Fogs and dews play no part in the direct spread of late blight from plant to plant but cultivation or walking through the fields when the plants are wet serves to spread the disease. Infection by late blight occurs most readily when the temperature is 60° to 65° F. The early morning hours during July and August are the danger periods and for this reason evening irrigation is inadvisable. The plants should be dry at night if possible.

Early blight is favored by high temperatures and infections occur most readily during July and August. Temperatures above 80° F. are especially conducive to outbreaks of early blight especially if these temperatures are accompanied by drought conditions which are favorable for the rapid dissemination of the spores of the fungus. The high temperature requirements of the early blight fungus explains why the disease is seldom important in Michigan and why it is nearly always a serious trouble in Florida celery fields. However, during the past three years the disease has assumed great importance in most of the celery districts of the Great Lakes region. Because of the potential danger to the 1933 crop, Michigan growers should be prepared to protect their plantings with protective dust or sprays.

Early Blight Controlled by Copper Dust or Sprays

Many complaints were received last year of the failure of Bordeaux mixture and copper-lime dust to control early blight. The failure to control this disease with these fungicides is not due to their ineffectiveness but to untimely and inefficient methods of application. Early blight infections may occur comparatively early and the disease gradually becomes established before sprays or dusts are applied. The general practice of most growers in the intensive districts is to neglect spraying or dusting in the early crop. This is because they have noticed that late blight causes little damage to the first crop. As a consequence, the disease comes in gradually and is ready for a rapid spread when conditions become more favorable. With scattered infections established throughout the fields in June, the early blight fungus is ready for a general attack with the onset of the hot weather of July and August.

Bordeaux mixture or copper-lime dust should be applied regularly throughout the growing season and sufficient quantities of material must be used to cover all parts of the plant. Few growers apply enough dust to afford more than partial protection. On the average, it will take about 35 pounds of 20-80 copper-lime dust per acre for each application or 100 gallons of Bordeaux mixture. Poor protection is being given if smaller quantities are used. Our observations show that not more than 20 pounds of dust are used by the average grower. This explains why difficulty has been experienced in controlling both early and late blight. Thorough coverage of the plants at sufficiently frequent intervals to keep all new growth coated with dust or

spray will give good protection against all leaf blights that attack Michigan celery. Growers are advised this year to make more frequent applications and to use larger quantities because of the additional danger of an outbreak of the early blight disease.

Especial attention should be given to the application of irrigation water. The lines should be run in the morning and never at night. About nine to ten hours continuous operation of the overhead lines is required to apply water equivalent to an inch of rain. Frequent light sprinklings are bad for celery and one or two heavy applications per week will supply enough moisture to keep the plants growing rapidly. The lines should be started about sun-up and continued until noon. *Never apply water in the late afternoon or evening.* To do so is to provide ideal conditions for the spread of leaf diseases. By careful attention to watering and by keeping the plants covered at all times with a protective fungicide both early and late blight can be prevented.

BULLETIN REVIEWS

Special Bulletin No. 228.—"The Rock Garden."—Halligan, C. P. and Wildon, C. E.—A bulletin of general information concerning the design and construction of the rock garden, the cultural requirements of rock plants, and a description of the more important kinds of plants for this purpose. (84 pages, 70 figures.)

A special supplement to this bulletin is published separately. It is a tabulation of the plants suitable for rock gardens that should prove of special value to the more advanced gardener who wishes some suggestions on the culture and use of rock plants that are somewhat less commonly grown. (41 pages.)

Special Bulletin 229.—"Rural School Organization in Michigan."—Thrun, F. M.—A report prepared in cooperation with the State Commission of Inquiry Into County, Township and School District Government. A survey was made of the rural schools in six selected counties representing various types of school situations to be found in the State. A physical inventory of the school buildings and the educational equipment was obtained, and a "spot map" prepared of each county, showing the boundaries of the school districts, and the residence location of each school child.

The survey shows that many economies, impossible under the independent district system, could be realized by enlarging the unit of administration. The greatest defect of the district form of school administration from the standpoint of financial efficiency is that it does not permit the most efficient use and planning of school facilities. (32 pages, 28 tables, 6 maps.)

Special Bulletin 230.—"Success and Failure in Spraying for Scab and Codling Moth."—Ricks, G. L. and Toenjes, W.—Records are presented showing great differences between fruit growers in the same districts in their degree of control over apple scab and codling moth, even when they follow the same spraying schedule. These differences were found to be due largely to differences in completeness of coverage in spraying. Many individuals fail to cover thoroughly the surfaces in the top centers of large trees; others fail to cover the inside (facing the trunk of the tree) surfaces of the fruits, because they do not force the spray through to the extreme opposite side of the tree from which the spraying is done. Experimental tests show that suitable attention to these two details in the technique of spraying results in greatly improved control of insects and diseases. (32 pages, 22 figures, 6 tables.)

Technical Bulletin No. 128.—"Anatomy of Phaseolus Vulgaris L. Black Valentine."—Doutt, Margaret T.—This publication traces the course of the vascular tissue throughout the plant and describes the development of the various tissues. The primary vascular tissues of the root have a tetrarch arrangement, and the primary phloem consists of sieve tubes, companion cells, parenchyma and a group of thick-walled fibers. The xylem is composed mainly of tracheids and some vessels, fibers, and parenchyma. No tannin sacs occur in the roots. In the stem above the cotyledons there are twelve distinct vascular bundles arranged in a circle, six large ones serving

as leaf traces and six as stem bundles. Large tannin sacs occur in the primary phloem as well as in other primary tissues. Secondary thickening produces a complete ring of xylem and phloem except where broken by rays, and also produces a hollow stem. The pericycle opposite the vascular bundles consists of fibers. An endodermis surrounds the vascular cylinder. The epidermis bears three types of hairs. The leaves have but one layer of palisade cells, and several layers of spongy tissue, and have stomata in both the upper and lower epidermis. The stipules have no palisade cells. The cotyledons consist of parenchyma cells. The united calyx of five sepals is supplied with fifteen bundles. Each petal and stamen has one trace, and the pistil three. The ovules attached to the placenta of the ovary at the ventral suture derive their vascular tissue from the arrangement in the root to the collateral arrangement in the stem takes place in the basal portion of the hypocotyl, eight bundles being thus formed. Portions of all eight hypocotyl bundles pass out into the simple leaves at the second node as the five traces which go into each petiole. At the third node, five whole bundles leave the stele and pass as traces to the compound leaf. (31 pages, 8 plates.)

Technical Bulletin No. 129.—"Studies on the Biological Decomposition of Peat."—Snyder, R. M. and Wyant, Z. N.—Raw peat of the Rifle type was composted for about a year with rock phosphate and solid and liquid manure in a large cement compost pit. Studies were made on bacterial and chemical changes occurring at different levels in the compost for ten months. The bacteriological observations included total counts, aerobic and anaerobic cellulose decomposers, rock phosphate decomposers, free nitrogen fixers, colon organisms, ammonifiers and nitrifiers and sulphate decomposers. It was observed that many of these groups are able to persist for a long period in the compost pit under anaerobic conditions. The availability of the rock phosphate increased about two and one-half times during 43 weeks composting.

This compost and two others similarly prepared were used, together with the same Rifle raw peat, in lysimeter tanks, using the compost in some cases as the top soil of the cylinder and in other cases as a bacterial inoculant. Sulphur, rock phosphate, manure, clay and sand were added to the cylinders in various amounts and combinations. The cylinders were cropped to buckwheat and oats for a period of nine years. Bacteriological observations were made on the cylinders, with particular reference to the groups of organisms mentioned above. The results demonstrate the persistence of manure organisms in soils treated with manure or manure composts over a long period of time. It was found possible to produce a new compost by incorporating into the raw materials a small amount of old compost. This new compost when used on raw peat proved as effective as the old one. A raw peat treated with manure or compost tends to maintain its fertility during the later years of long continued cropping. (64 pages, 4 figures, 6 plates, 36 tables.)

Technical Bulletin No. 130.—"Field Studies of Bud Sports in Michigan Tree Fruits."—Drain, B. D.—This bulletin contains descriptions and historical data relating to a large number of bud variations of apples, cherries, peaches and plums found principally in Michigan. It is pointed out that on the whole such sports are of rather frequent occurrence and that they affect practically every feature of the tree's growth. Only a very small percentage are of such a type that they constitute an improvement over the parent forms, though some superior strains originate in that way. The

unintentional or careless propagation of inferior or degenerate sports that is constantly going on results in more or less objectionable intravariety diversity and in a certain amount of deterioration of stock. (48 pages, 6 tables, 18 figures.)

Technical Bulletin No. 131.—"The United States Export and Import Trade in Dairy Products."—McDonel, Karl H.—This bulletin presents a discussion of the world trade in dairy products, with particular reference to the foreign trade of the United States in these products. The history of the United States tariff changes affecting the dairy industry of this country is discussed, and the effect of a reduction or an increase in the tariff rates on the volume imported of fluid milk and cream, cheese, butter, and casein. (38 pages, 6 figures, 22 tables.)

Technical Bulletin No. 132.—"Soil Testing—A Practical System of Soil Diagnosis."—Spurway, C. H.—This bulletin describes a system of testing soils for certain easily soluble components by means of qualitative chemical tests arranged on a quantitative basis. Tests are described for nitrates, phosphorus, potassium, calcium, carbonates, the soil reaction, ammonia, nitrites, magnesium, iron, aluminum, manganese, sulfates, chlorides, and sodium. In connection with each test suggestions are given concerning the interpretation of the test results. Complete directions for the preparation of the several chemical reagents used in making the tests and a list of the necessary apparatus are given in the bulletin. Eight color charts are also included for reading the magnitude of the test results. The bulletin is intended chiefly for county agricultural agents, teachers of agriculture, soils extension workers, soils research workers, garden specialists, and others who can use chemical tests for diagnosing soil deficiencies or for comparing soils on the basis of their easily soluble chemical components. (16 pages, 8 color charts.)

JOURNAL ARTICLE ABSTRACTS

"Control Measures for Apple Tree Borers."—Hutson, Ray.—66th Annual Report of the Entomological Society of Ontario, pp. 46-47. 1931. (Published in 1933.) (Journal Article No. 79 (n. s.) from the Michigan Agricultural Experiment Station.)—In a series of tests, paradichloro-benzene-cottonseed oil and calcium cyanide-cottonseed oil mixtures proved effective against apple tree borers, particularly *Chrysobothris femorata,* the flat-headed apple tree borer, on many kinds of deciduous fruit and ornamental trees. Tests at various seasons of the year show that either of these two materials can be used for the control of pests with a wide margin of safety to the trees. Probably the best time for the application is during the fall, although equally successful treatment can be made in the spring. It is not advised that treatment be made during the time that the tree is growing rapidly. The tests indicated an advantage in favor of one pound of paradichlorobenzene dissolved in two quarts of raw cottonseed oil. This, when painted on the dark areas caused by the activity of the borer, without permitting the material to run down the bark of the tree, killed borers without injury to apple, buckthorn, birch, beech, maple, and thorn trees. Trial of different methods of application indicate that for flat-headed apple tree

borer probably the best means is by painting the material on the affected area, while for round-headed borers the use of a pressure gun, such as that used for greasing automobiles, is very effective.

"A Simple and Rapid Method for Measuring the Stickiness in Soils."—Bouyoucos, George.—Soil Science. 34(5):393-401. 1932. (Journal Article No. 93 (n. s.) from the Michigan Agricultural Experiment Station.)—A simple, rapid, and fairly accurate method has been developed to measure quantitatively the maximum stickiness in soils. The result obtained show that this maximum degree of stickiness, measured in pounds per square inch required to pull a metal disk from the soil, varies from 0.0 pounds in muck and sand to about 10 pounds in some of the clays. There is a fairly close relationship between the maximum stickiness and clay content in most soils, but in some soils this relationship is very slight. There is also some, though not a close, relationship between the maximum stickiness and the upper plastic limit in most soils, but there are some very distinct exceptions.

"Some Relationships Between Water Plants and Water Soils in Michigan."—Veatch, J. O.—Papers Mich. Acad. Sci. Arts and Letters. 17:409-413. 1932. Published March, 1933. (Journal Article No. 96 (n. s.) from the Michigan Agricultural Experiment Station.)—Studies were made of water-covered areas of Michigan, mainly inland lakes, from a soil, or pedologic, point of view, and correlations between kind of water and bottoms and the plant growth were attempted. From about 300 observations widely distributed over the State, a range of pH from 6 to 9.2 was found, and a hardness of water expressed in grains per U. S. gallon from 1.5 to 20. Ten types of lake "bottoms," or sub-aqueous cumulose horizons, were recognized. The most prolific growth of attached plants appears on the soft, slimy, sedimentary peat bottoms, and on the clayey muds; the least growth on the sand, cobbles, and hard bed rock. The conclusion was reached that most of the aquatic plants observed grow under a wide range of soil conditions, but a few are limited to certain soil conditions, as for example Chara, to waters which are definitely alkaline in reaction and high in calcium. The observations made support a theory that many of the present acid or soft water lakes and bogs, covered with acid tolerant plants, were originally alkaline, or hard water lakes, and the change to the acid conditions has been brought about by filling of the lakes with vegetation to a point where only a small depth of water remains. At this point acid tolerant plants may gain a foothold and convert the area into an acid bog or an acid peat swamp.

"Changes in Volume That Occur When Dry Soils are Wetted With Water and With Chemical Solutions."—Bouyoucos, George.—Jour. Am. Soc. Agron. 25(2):129-133. 1933. (Journal Article No. 98 (n. s.) from the Michigan Agricultural Experiment Station.)—An investigation was conducted to ascertain the volume changes that take place when oven-dry soils are wetted with water and with different chemical solutions. It was found that the original or absolute volume of the soils and liquids considered together decreases when the soils are brought into intimate contact with the liquids. The volume contraction varies with the different soils, being greatest in clays and in soils with high organic matter content. With the exception of KOH solution, the volume contraction in all the chemical solutions used was the same as that in water, in any given soil. That in the KOH was greatly less. The volume contraction is probably due to the compression

of the water adsorbed by the soils. When soils are saturated with water or chemical solutions and swell and increase in volume, this increase in volume is only apparent and not real. In the real volume there is a decrease.

"A Method for Determining Combined Water and Organic Matter in Soils."—Bouyoucos, George.—Soil Science 34 (4): 259-267. 1932. (Journal Article No. 103 (n. s.) from the Michigan Agricultural Experiment Station.)—A successful method of distillation is presented for determining the combined water in soils. The soil is placed in a bomb and heated at a high temperature. The combined water is distilled over very rapidly, condensed, and caught in carbon tetrachloride. Because the combined water can be determined, the ignition method now becomes more accurate and reliable for determining the organic matter in soils.

"Volumetric Method for Determination of Fluorine."—Willard, H. H., and Winter, O. B.—Ind. Eng. Chem., Anal. Ed. 5(1):7-10. 1933. (Journal Article No. 105 (n. s.) from the Michigan Agricultural Experiment Station.)—A method is described for titrating soluble fluoride and silicfluoride solutions with standard thorium nitrate, using a zirconium-alizarine mixture as indicator. When interfering elements are present the fluorine is volatilized as hydrofluosilicic acid by placing the sample, together with a few glass beads or pieces of porous plate, water and perchloric acid in a small distillation flask and boiling. The temperature should be maintained at approximately 135° by the addition of water as the boiling proceeds. Materials which cannot be decomposed with perchloric acid must be fused with sodium carbonate before the fluorine can be volatilized. A study was made of the method of volatilizing fluorine as silicon tetrafluoride by means of silica and anhydrous sulfuric acid. The method did not give satisfactory results on some materials. An attempt was made to volatilize flourine as hydrofluoric acid. The results were inconsistent.

"A Yeast Extract Medium for Determining the Bacterial Content of Milk by the Plate Method."—Devereux, E. D. and Etchells, J. L.—Amer. Jour. Pub. Health. 22:139-151. 1933. (Journal Article No. 121 (n. s.) from the Michigan Agricultural Experiment Station.)—A yeast extract agar medium is described that when used for determining the bacterial content of milk by the plate method, gave counts at the end of 24 hours incubation which were on the average comparable to plain agar counts made at the end of 48 hours, thus resulting in a saving of 24 hours for the completion of the test. Also it gave counts at the end of 48 hours which were on the average 45 per cent higher than similarly made plain agar counts.

"The Adsorption of Electrolytes by Ash-Free Charcoal." VII.—Miller, E. J.—J. Physical Chemistry. 36:2967-2980. 1932. (Journal Article No. 122 (n. s.) from the Michigan Agricultural Experiment Station.)—In this paper, which was presented at the Tenth Colloid Symposium June 16-18, 1932, in Ottawa, Ontario, data are presented which show that the negative adsorption of the strong inorganic bases by activated ash-free charcoal decreases with length of time the charcoal remains in contact with the solution. It was found necessary to heat the charcoal at 1000° C. or above in order to produce negative adsorption of sodium and potassium hydroxides. Data are also presented to illustrate the practical impossibility of quantitatively removing even a slightly adsorbed acid such as hydrochloric by repeated ex-

traction with boiling conductivity water. From an electrodialytic study it was found that by electrodialysis the adsorbed hydrochloric acid can be quantitatively removed, but a fundamental change in properties of the charcoal results.

A critical survey of the present status of facts and theories of adsorption of electrolytes by ash-free charcoal is included. No one theory alone seems capable of satisfactorily explaining all the known facts of adsorption by adsorbent charcoal.

"The Influence of Manufacturing Operations Upon the Microbial Content of Grape Juice."—Fruit Products Jour. *12*: 141-142. 1933. (Journal Article No. 134 (n. s.) from the Michigan Agricultural Experiment Station.)—A study was made of the microbial content of grape juice during the process of its manufacture. Samples collected immediately after crushing and plated on malt extract agar were found to contain many thousands of yeast (approximately 140,000 per cc.) and a few molds. Heating the pulp to 145° F. momentarily reduced the count very materially but did not sterilize it. After the pulp had been pressed the yeast count again showed an increase (approximately 20,000 per cc.). Heating the juice to 195° F. momentarily sterilized it. However, foam taken from the juice at this point showed an average of 265 yeasts per gram. The juice, as it entered five gallon storage carboys, was sterile in all cases examined, except one which had a mold present. The carboys were then heated to 145° F. for 30 minutes, partially cooled and stored. Grape juice so processed showed no evidence of spoilage.

"Faulty Pasteurization Responsible for Moldy Grape Juice."—Fabian, F. W.—Am. Fruit Prod. Jour. and Am. Vin. Ind. *12*:173-175. 1933. (Journal Article No. 144 from the Michigan Agricultural Experiment Station.)—An investigation was made of a grape juice plant which was having trouble with moldy grape juice. A study of the microbial content of all piping and machinery used in bottling the grape juice showed that the use of hot water for rinsing the system was not sufficient to destroy the microorganisms present. The system contained a great many microorganisms most of which were pink, black and white yeasts and a few molds. Microbial studies on the grape juice at different points in the plant during the process of bottling and after it had been stored in five-gallon glass carboys, showed that as it passed through the various processes incident to bottling it collected many hundreds of yeasts and a few molds. Heating the juice to a temperature of 150° F. momentarily before bottling apparently sterilized it. When the grape juice was bottled and pasteurized at a temperature of 180° F. for 11 minutes, there was considerable trouble with molds developing in the bottled product. Slowing the speed of the pasteurizer so that the bottled grape juice remained in the pasteurizer at 180° F. for 37 minutes corrected the trouble.

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LIST OF AVAILABLE BULLETINS

Regular Bulletins—

262 Suggestions on Planting Orchards.
264 Second Report of Grade Dairy Herd.
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286 Studies and Cost of Milk Production—No. 2.

Special Bulletins—

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MICHIGAN AGRICULTURAL EXPERIMENT STATION

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DEPARTMENT OF THE MICHIGAN STATE COLLEGE OF AGRICULTURE AND APPLIED SCIENCE, AND, WITH IT CONTROLLED BY THE

INCORPORATED STATE BOARD OF AGRICULTURE

STATION COUNCIL

ADVISORY AND ASSISTANT STAFF

SUB-STATIONS

Chatham, Alger County, 780 acres deeded, G. W. Putnam, Director.
South Haven, [illegible]n Buren County, 10 acres rented; 5 acres deeded, S. Johnston, Superintendent.
Graham Station, Kent County, 50 acres donated by R. D. Graham; 50 acres purchased, Walter Toenjes, Superintendent.
Dunbar, Chippewa County, Forestry Station, 577 acres deeded, Putnam Robbins, Superintendent.
[illegible]ke City Experimental Potato Farm, Missaukee County, 640 acres purchased or under contract. Ashley Berridge, Superintendent.
Kellogg Demonstration Farm and Wild Life Sanctuary, Kalamazoo County, 900 acres donated by W. K. Kellogg; C. M. McCrary, Superintendent.
Monroe, Monroe County, Corn Borer Station, 7½ acres rented.